W. B. MEACHAM.

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THE NOSE, THROAT AND EAR

GILE

THE
NOSE, THROAT AND EAR

THEIR
FUNCTIONS AND DISEASES

A TREATISE UPON

THE BREATH-ROAD, FOOD-ROAD AND ACCESSARY ORGANS

BY

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PREFACE

In recent years Laryngology has developed at a rate equalled by few of the other specialities. Many morbid conditions have been investigated, described and classified; new operations have been devised and new instruments invented. These advances have been accompanied by the publication of many essays, theses and monographs, whose wide circulation proves that the subject has interest for many beyond the group of those pursuing it as an exclusive vocation. A stage has now been reached where the accumulation of facts, recorded by numerous observers, is so great as to demand of the student a long period of study, and to severely tax his memory. This is, indeed, but one phase of the difficulty which besets all medical study—too much to learn—the difficulty which has forced the colleges to more than double the length of the curriculum.

With every hour of the longer under-graduate course already appropriated, and the field of knowledge growing broader continually, it is imperative to economize time and to employ efficient methods of study; or the man entering upon practice may find himself not equipped, but burdened by a mass of information imperfectly acquired and inaccurately remembered, a mass which, large as it is, does not supply what he needs in his daily work. Among those holding staff positions in hospitals the complaint is general that many assistants are poorly prepared and yet these assistants are picked men, chosen for their supposed competence.

The most practicable corrective of our present difficulties is the improvement of methods of study. To retain ten separate, unassociated ideas puts more strain upon the memory than to recollect a hundred classified ideas, which constitute a mnemonic chain, each link possessing qualities which suggest the adjoining links by a natural association. The great importance of a logical sequence of ideas, not only to the reasoning faculty, but also to the memory, is shown in some of the older sciences, as

for example chemistry, which by long development have attained a measure of exactitude, nearly mathematical, and in which thousands of facts are so acquired and remembered that, when needed, they can be brought up by a chain of association. Laryngology is a branch of science, whose growth is too recent to render it exact. It gives opportunity for only a partial classification and such opportunity as it does offer has not been utilized. This is very much to be regretted since, being a specialty, its teaching is almost wholly post-graduate and there is very little opportunity for didactic lectures or systematic instruction in any form. With slight exception, the training is clinical and this is unsystematic; because the order in which topics are presented depends upon the material available. When the class is assembled, the first case may be one of aphonia due to acute laryngitis; the second case otitis media; the third patient may have an adenoid and the fourth a foreign body in the nose. When facts are presented in this way, a great many are soon forgotten and, even worse, the student forms the habit of thinking in an illogical and slipshod manner. When afterward, in his own office, wholly dependent on his own resources, he encounters an emergency, he is in the plight of the journeyman mechanic, who tries "to think up what the boss did, when he was in such a fix." Instead of this haphazard guessing, the specialist's mind should be so trained, that the character of the emergency itself would call up by a chain of associated ideas the exact remedial procedure required.

We cannot expect to secure for our specialty more time in the crowded under-graduate curriculum; nor can we change the trend of clinical teaching, which must continue to utilize the cases which chance brings into the teacher's hands; but there is a way of improving this post-graduate course; a way simple and yet quite efficient. That way is to coördinate the clinical demonstrations with the didactic teaching of a systematic text book. Such a book should be read with care at the outset of the special course and the essential principles and most important facts fixed in the memory; then, after each day's clinical demonstrations, the lessons learned should be compared with the chap-

ters dealing with those same subjects, resemblances and divergences should be considered and note taken of new statements which are significant. So working, the student will gradually and naturally incorporate what he sees with what he has read; text book and clinics will supplement each other, scattered facts will find their proper place and relation, and he will acquire a body of systematized knowledge, which will be his very own and which will come to his aid as promptly and as surely as the letters of the alphabet. The text book, so studied, should be his companion through the years. New works he will read, new operations he will perform, new ideas assimilate; but all will fit into their proper places, in the framework created during his period of preparation; and the book in every part, the notes upon the margins, the memoranda upon interleaved pages, even the dogear marks and soils upon the paper, will be so associated with his thought and work, that no other volume can possibly take its place.

A number of text books have been published, both here and abroad. Much credit is due to their authors for fidelity and industry in collecting facts and, in some cases, for elaborate and instructive illustrations, anatomical and surgical. In the matter of systematic arrangement these works are open to criticism. In some of them logical plan is so completely ignored, that the order of chapters in the table of contents might be reversed, without affecting the value of the book. Even the various sections of a single chapter may be as separate and independent as the articles by different writers collected in some encyclopædia of medicine. These books are indeed storehouses; but much like the freight room of a railroad, they contain articles of the most diverse character heaped together indiscriminately. The reader, striving to memorize the valuable truths presented, lacks altogether the aid of sequence and association and, unless specially gifted, he will forget more than he retains.

In composing the following book, I have taken as my basis a few anatomical facts, which together with their physiological relations underlie the normal condition of the part of the body,

with which we are specially concerned. Modifications of these relations and of some accessary functions cause the processes of disease, whose study from various standpoints constitutes the scientific foundation for pathology, diagnosis and therapeutics. Although a complete classification is not possible, the majority of our facts can be grouped in accordance with such a plan, and its adoption makes practicable a logical succession of ideas so connected that, when wanted, they can be recalled by natural associations of thought.

While fully conscious of defects in the execution of this plan, I believe that the system adopted will aid both students and practitioners, by economizing their time and rendering their knowledge more available, thus conferring a real benefit upon all who devote themselves to this highly important and most interesting specialty.

In the following pages I have availed myself of the labors of many laryngologists, both native and foreign, who through books, lectures and personal conversations have given me instructions of the highest value; but I have mentioned few names, unless they were necessary to identify some operation or some instrument. This course has been followed because bibliographical matter is inappropriate in a treatise, whose aim is to give in the most compact form the practical information needed by the student and clinician. I specify here only those to whom my obligation is greatest; but I wish to ackowledge indebtedness to many others who have contributed to the common fund of knowledge from which we all draw. Our gratitude for what we receive is best expressed by contributing to this common stock something approved by our own experience and which will be of value to our colleagues.

To my former teachers, Drs. Charles S. Potts, B. Alexander Randall and George C. Stout, I return most cordial thanks for the interest they have shown in my work; for the use of their valuable libraries placed at my disposal and for many other proofs of their highly valued friendship.

Ben Clark Gile.

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NOSE, THROAT AND EAR

CHAPTER I

THE SCOPE OF LARYNGOLOGY

The five orifices of the head, the mouth, nostrils and ears, with the adjoined passages and contiguous structures, constitute a well-defined region, which though of small extent furnishes the stage for some of the most important and wonderful manifestations of vitality. This region is the province of our specialty and it is unfortunate that medical nomenclature furnishes no comprehensive term, distinctively expressing the sum of our knowledge concerning it. Its divisions have suitable names: rhinology comprehends everything relating to the nose; otology all that pertains to the ears; but we have no inclusive designation covering the entire ground. To supply the need for such a word, laryngology has been given a wide meaning which embraces that of the other terms. It is consequently used in two senses: its primary signification which pertains to the larynx only, and a derived signification of inclusive scope, and this is now the more common sense, so that when one speaks of laryngology, he means the entire speciality, comprehending under the title rhinology, otology and pharyngology, as well as laryngology in the narrow meaning of the word.

The region with which we are concerned has anatomical and physiological relations with other parts of the organism, which should be thoroughly understood at the start. A correct and useful idea of these relations can be acquired and remembered by regarding the body, exclusive of the limbs, as com-

posed of two cylinders, irregular in contour and parallel in position. The posterior cylinder consists of the spinal column, an osseous tube expanding at the top into the skull. This tube with its spheroidal extension contains the spinal cord, the brain, and the cerebro-spinal fluid. Within it are located most of the centers of neural and psychic functions.

The anterior cylinder is somewhat shorter, but of much greater circumference. Throughout its length, from the lips to the anus, it is traversed by a canal (prima via) lined with mucous membrane and permitting the passage of gases, liquids and small solid bodies. Its walls consist chiefly of bones, muscles and adipose tissue, and between them and the central canal are the visceral organs, all of which are concerned in the essential and complex process of nutrition. This cylinder comprises three regions, in each of which the soft tissues of the walls are attached to bony frames and further sustained by the lateral processes of the spinal column.

The lower region accommodates the abdominal and genito-urinary organs, its soft tissues being supported by the bones of the pelvis. The middle region, or chest, contains the respiratory and circulatory organs and its mural framework consists of the ribs and sternum. In the upper region the soft parts are suspended from the bones of the face and their contour is maintained by attachments to the cervical vertebræ.

This third region extends vertically from the base of the skull to the sternum and includes everything in front of the spinal column. In the adult its perpendicular diameter measures six or seven inches and the length of transverse diameters varies from three to five inches, in accordance with the part of the face or throat through which they are drawn. The region thus occupies a very small space, but it has many features peculiar to itself and which prove to the earnest student a source of unfailing interest and the incentive to persistent study. Its most striking peculiarity is that the organs located within its boundaries are of less importance than are the two passageways; the breath-road and the food-

road; by which it is traversed. The disabling, even the removal, of the organs is not necessarily fatal and, to some degree, compensation for their abolished functions can be made by organs in other regions, but the breath-road and the food-road are indispensable; occlusion of the one entails death by suffocation; of the other death by starvation. To keep these roads open is an imperative indication of treatment and entire freedom of movement is so important that obstruction, more or less serious, is the common factor present in nearly all the diseases requiring our attention. The activities of the organs contiguous to these highways are in large measure auxiliary to the unimpeded passage of air and of solid and liquid nutriments; but there are some whose functions are accessary and which, though highly important, are not necessary to this movement and hence not essential to life.

The organs accessary to the breath-road are: (1) the terminals of the olfactory nerves furnishing the sense of smell, (2) the ears, the instruments of hearing and (3) the vocal cords, producing the voice. Similarly, the accessories of the food-road are: (1) the teeth, (2) the salivary glands and (3) the terminals of the gustatory nerves supplying the sense of taste. The complex process of articulate speech, restricted to the human race, and developed much later than voice and the special senses, results from the coöperative action of many organs anatomically associated with the food-road though, as it is a development or elaboration of voice, its physiological place is with the functions accessary to respiration.

Fig. 1 shows in a diagrammatic way the routes of the great roads mentioned, and designates the functions of the accessary organs.

The scope of our specialty, viewed in its varied aspects, may be summarily stated as follows: Anatomically it embraces the upper region of the anterior cylinder of the body, the roads traversing it and the organs auxiliary and accessary,

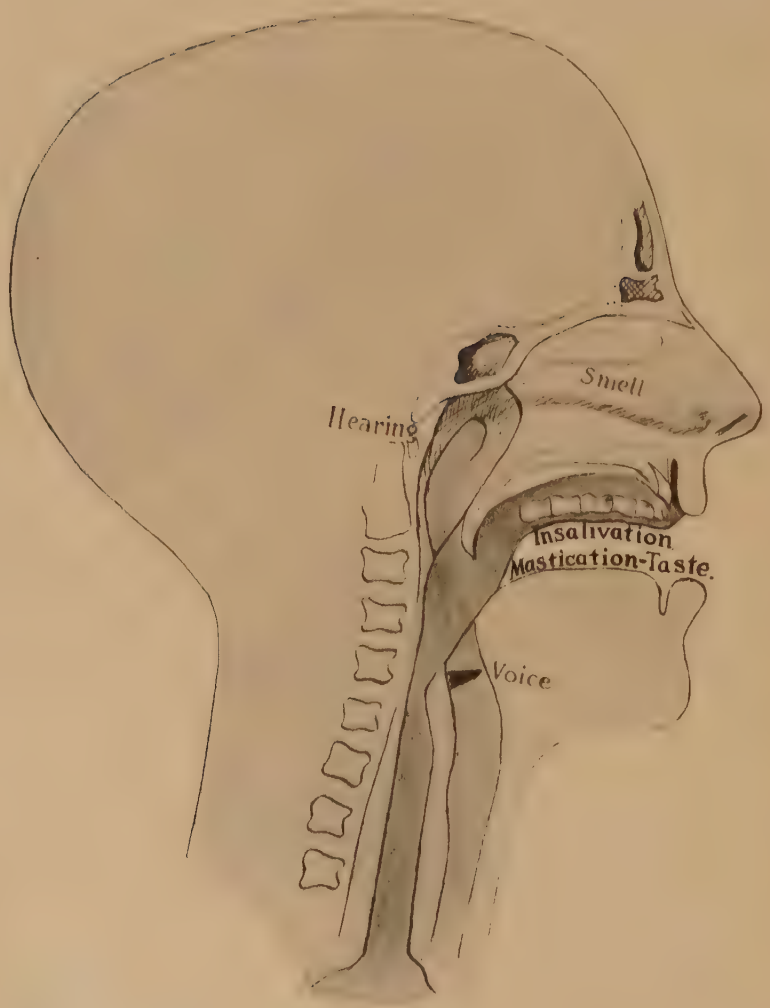


FIG. 1.—Schema of the breath-road (animæ via) and the food-road (prima via). In the pharynx the two roads coincide. The words smell, hearing and voice indicate the functions of the organs accessary to the breath-road. The words mastication, insalivation and taste are in a similar way associated with the food-road.

located within its bounds. Physiologically it includes the ingress and egress of respired air, the course of solids and liquids along the food-road, the activities correlated with these movements and the functions of accessary kind comprehending those causing the phenomena of the special senses of smell, hearing and taste and those producing voice and articulate speech. Clinically it considers the obstacles of every sort, which obstruct the normal movements along the roads, investigates their causation and attempts their removal. It investigates the pathogenic substances which enter through the orifices and work mischief within the region, or migrate beyond its boundaries and do harm to other parts of the organism. It endeavors to prevent or repair damage of this kind. It also deals with the abnormalities and diseases of the accessary organs, especially those concerned in the highly important functions of audition, phonation, and articulation.

There are some topics extraneous to this classification, but their number is small and the outline here given furnishes what, in the light of our present knowledge, is a just idea of the Scope of Laryngology.

CHAPTER II

DIAGNOSIS AND ETIOLOGY

The importance of diagnosis is recognized by every one. Failures to reach a correct result are often due to an erroneous method of reasoning, but are attributed to ignorance, carelessness, or even greed, and seriously damage a physician's reputation. These truths are exemplified by the following illustration.

A man had an obscure neurosis which produced spasms of some of the involuntary muscles. The attacks occurred at irregular intervals and lasted for a few hours. Deglutition was much impaired and there was retention of the urine and fæces. The trouble was of long standing; but did not prevent the patient attaining a high place in the financial world. When he was fifty years old, there occurred a marked exacerbation of the bladder symptoms, which became continuous. Urination was frequent, but scanty; sometimes the stream would be suddenly interrupted and vesical discomfort was almost constant. The patient applied to a professor in one of the medical colleges, who went into the history of the case very fully and gave the opinion that the seat of the disease was in the cord and spinal nerves. He did not explore the bladder, or make a chemical examination of the urine; but instituted active treatment with ergot, galvanism and counter-irritation over the perineum and spine.

This was continued several weeks, but the patient's condition grew steadily worse, until he yielded to the anxious solicitation of his wife and put himself in the hands of one, who had formerly cured her of an acute illness. This doctor, who had not a tythe of the professor's reputation, heard the patient's story without comment and then, at once, passed a sound through the urethra. The instrument had scarcely entered the bladder

when it struck a solid body, which was afterward shown to be a large calculus. Its removal by lithotomy put an end to the lately developed bladder symptoms; but the old neurotic manifestations continued with little change.

The professor's mistake was not due to haste; certainly not to ignorance; for he had discovered and removed many calculi. The fault was in his process of reasoning. Impressed by the history, he had from the start regarded the cause as neural and his subsequent thinking was influenced by this preconceived opinion. When the treatment proved inefficient, he should have reëxamined the grounds of his diagnosis; but with overconfidence he continued to use the remedies adapted to his theory of the case and gave slight heed to the significant changes in the function of urination, neither making a test of the fluid, nor exploring the bladder.

This blunder was of the kind which make an impression upon the laity. It cost the professor much in loss of reputation and brought many reproaches from the business and social acquaintances of the patient. If the diagnosis made by analysis had been compared with results obtained by the synthetic method, the mistake would have been avoided.

Similar errors in reasoning appear to be frequent and just as common among men, who have had five or six years of college and hospital instruction, as among the product of the old course of two short terms. If the present-day graduate is deficient in the reasoning needed for correct diagnosis, that deficiency should be made up by postgraduate instruction, hence the matter will be briefly considered here.

The analytical method of diagnosis is indispensable and is used at every bed side. The clinical data comprise the following:

1. The symptom complex, or description of the case.

2. The history furnished by the patient or others cognizant of the facts, a narrative going back as far as the doctor desires, or the conditions permit.

3. The physical examination: knowledge the doctor gains by using his own senses and such assisting instruments as the

stethoscope, clinical thermometer, laryngoscope, urethral sound, sphygmomanometer, etc.

4. Perhaps, the laboratory findings regarding various normal or abnormal substances derived from the patient's body, or in some way associated with him. Such information, chiefly of a chemical and microscopical sort, is not usually required, the diagnosis being established by the data under the other three heads; but, in cases of doubt, this supplementary information is frequently invaluable.

These four categories include the *Res omnes propriæ Morbi*, the sum of knowledge upon the subject. It is by analyzing these data, proceeding from the known, to the unknown, working from effects back to causes, that the clinician reaches a concept of the origin of the symptoms, the physical signs and the laboratory findings. That origin he recognizes as identical with one of the diseases he has studied and in designating that disease he expresses the results of his diagnostic investigation. Nine times out of ten he will be right, but in a few instances he may overlook some of the facts, or give them too little weight; in other cases he may attribute an effect to one cause solely, ignoring another cause, which is equally capable of producing that effect. In such ways he may go astray and when on the wrong road wander further and further from the right pathway.

It is just under these circumstances that the synthetic method proves exceedingly valuable, because it corrects the errors of the analytical plan. It has fallen into neglect with the decay of didactic teaching but every physician should understand it and should resort to it, whenever the diagnosis is doubtful and especially when he is disappointed in the effect of his therapeutic measures; because the failure of remedies, which usually succeed, is a mandate to reinvestigate the diagnosis.

The synthetic plan of study begins with general morbid processes and then considers the important diseases, one after another, striving to gain a concept of each; a mental picture, in which the chief characteristics are so depicted that when

seen in practice they will be easily recognized thus identifying the actual malady with the idea retained by the memory. In making a diagnosis the symptoms and other data are compared with those mental concepts, which relate to organs and functions within the same range of thought, and conclusions are drawn from the resemblances and divergences.

If this method had been used in the illustrative case given above, the steps in the reasoning process would have been as follows: There is vesical pain, frequent, scanty urination, and sometimes sudden interruption of the flow. Do these symptoms correspond with the features of any disease of the genito-urinary system? The memory calls up, one by one, the mental concepts of diseases of this group. Stone in the bladder has held a place in nosology for over twenty centuries; some of its well-known symptoms are identical with those of the present case, hence a stone may account for the phenomena. At all events, there is here sufficient probability to impose the duty of exploring the bladder, and if this does not give positive results, of analyzing the urine. The bladder exploration would have given positive results to the professor, as it afterward did to the other physician, and the diagnosis would have rested upon a safe and certain basis.

The practitioner of long experience may rapidly reach a correct diagnosis, though even for him there is danger in haste, but the beginner should proceed carefully and deliberately, omitting no step of the reasoning process. He will thus form the habit of thoroughly covering the field and of reaching a diagnostic conclusion, which he can both accept and defend. Every abnormality observed should raise in the mind of the diagnostician four etiological questions. Their asking and answering will promote a habit of thinking logically and comprehensively and will prove a valuable safeguard against error. These questions are helpful to every doctor; but specially so to every laryngologist.

First stands the inquiry: Is this abnormality congenital? In the structures contiguous to the breath-road and food-road

anatomical variations are quite frequent and some of them are congenital. They may be slight and compatible with full functional activity and yet may give trouble when an operation is performed. For example, a redundant anastomosis may render a hæmorrhage much harder to control. The importance of the question referred to is made manifest by an inquiry of almost daily occurrence. There is an organ in an abnormal state and there also exists a detrimental process. Is the latter caused by the former? We find that while the process has lasted six months the abnormality is congenital. Obviously, if it were the cause of the process, that process would have begun long before: its cause lies somewhere else; hence operating upon the organ will not change the process. Such mistaken operations have often been done with most disappointing results. If an abnormal condition is not congenital, it must have been produced later and this fact leads to the second inquiry:

Is this abnormality traumatic? People often forget accidents, particularly those which happened in childhood, and careful questioning may be necessary to elicit the story of some injuiry received in school days, but the knowledge is well worth the trouble it costs. Suppose there is a cicatrix in the vestibule of the nose: it makes a great difference whether this scar is the vestige of a wound or of a syphilitic ulcer. The nasal and pharyngeal membranes often bear the marks of former operations and these signs may be the clues to former conditions, having an important bearing upon the patient's present situation, and may give much aid toward a correct diagnosis.

In the third place, comes the inquiry:

Is this abnormality due to some hidden foreign body? It is not here intended to refer to bacteria; but to those extranea, either animate or inanimate, which if uncovered are visible to the naked eye. Such intruders are more numerous than is commonly supposed. The rhino-laryngeal region, like the coat of St. Lazarus, is full of holes. These cavities furnish hiding places for extraneous things of many sorts, sometimes

of very curious and unlikely description. The length of time such foreign bodies remain undiscovered is often as strange as the things themselves. Where there is any possibility of their presence the physician should look for them. If properly made, the inspection can do no harm and, in an unexpectedly large proportion of cases, it will disclose articles of which the patient is unaware. These things are harmful and may cause not only the obstructive, inflammatory and degenerative troubles, which we would naturally anticipate, but also secondary and remote damage of a most unexpected kind. Our minds should be alert to this possibility; for the removal of some long concealed foreign body has, in a number of instances, caused the cessation of distressing symptoms, although no etiological relationship had been established. Usually, when we have found such an intruder, our duty is plain: with rare exceptions, its removal is the safe and proper course. This procedure sometimes impresses the popular imagination, particularly where the body extracted is of an unusual or grotesque kind, and the surgeon gains a higher reputation than rewards work requiring much greater skill. The importance of inspecting the cavities in which some foreign body may be hidden, in every case where the diagnosis is obscure and the treatment unsuccessful, is well shown in the following narrative.

A mine owner of Arizona, overtaken by darkness in the mountains, had slept all night upon the sandy ground. The next day he was attacked by a severe frontal headache, which slowly yielded to medical treatment; but returned some weeks later and afterward recurred, at irregular intervals, for a period of two years. The pain was accompanied by dizziness and some confusion of thought. If the patient tried to walk in a straight line he was deflected to one side and, if the eyes were closed, this deflexion increased to a nearly circular movement. The physicians, to whom he applied, were mystified and failed to do him any good. The last in order advised rest and travel; so the patient went to Germany and consulted several professors of renown. They began treatment hopefully, giving

him baths (of course) and mineral waters and massage and electricity. It was all of no avail and the patient resolved to give up physicians and go home "to grin and bear it." During the ocean voyage, a fellow-passenger persuaded him to make one more effort for recovery by consulting a Philadelphia physician in whom she had great confidence.

To this doctor's mind the headache and circular locomotion suggested the possibility of disease in the labyrinth of the ear and his first question regarded the aural condition. To his amazement, he learned that, from first to last, no one upon either side of the Atlantic had examined the ears. Five minutes later he withdrew from the left meatus the dead body of a small moth, which the patient recognized as belonging to a species of poisonous insects common upon the southwestern plains. Its feet and mouth had been adherent to the membrana tympani, which showed a sub-acute inflammation. For this the doctor gave treatment; but he encouraged no great expectations, simply remarking that some benefit would result from the removal of the moth, which doubtless had crept into the patient's ear during the night he slept upon the ground two years before. The sequel proved that irritation communicated from the external ear to the delicate structures within, was the sole cause of the long-continued disturbance, for as the drum head became normal, all the symptoms disappeared and, in a week's time, the patient, enthusiastically grateful, resumed his homeward journey, a well man.

One inquiry remains:

Is this abnormality due to micro-organisms? Bacteriology is so habitually present in our thinking, that there is small risk of overlooking its etiological importance; the danger is rather that we may attribute too many things to the activity of microbes. Many acute diseases are undoubtedly due to them and their presence may be inferred from clinical signs, without an actual demonstration. If we are on debatable ground, then recourse must be had to the laboratory with its chemical and microscopical tests. The laboratory findings

are a part of our diagnostic data and as evidence may be considered upon the same plane with the other premises upon which the conclusion is based. The laboratory expert should expect nothing more than this. The claim that the data he furnishes are more trustworthy, more scientific, than what the clinician finds, is utterly baseless. Mistakes are as frequent in the laboratory as elsewhere and, when the establishment is run upon a wholly commercial plan, its reports are of little value. In some such places the actual testing is done by incompetent female employees of the shop-girl type and the results deserve no confidence whatever. The necessity of a division of labor has forced physicians to resort to an outside laboratory for part of their information, but in doing so they introduce an element of doubt and the danger of error is greater than if the entire investigation was made by the clinician himself. If he were obliged to take another man's report of the cardiac and pulmonary sounds, instead of using the stethoscope himself, his faith in the diagnosis would be shaken and the danger of fallacious results would be greatly increased. Similar doubts and dangers are inherent in the second-hand statements coming from the laboratory outside the physician's office.

Proper replies to the four diagnostic questions, which have been considered, will cover the etiology of the majority of the abnormal conditions encountered in practice. The remaining inquries are not numerous and will present little difficulty to one who has faithfully followed the method of investigation here advised, and has thus eliminated what is congenital, traumatic, extraneous and bacterial.

When the physician has by patient and intelligent investigation established a diagnosis, which fully satisfies his own mind, he can proceed to the treatment actuated by a confidence that will impart purpose and force to his therapeutic measures, and also inspire the patient with a hopefulness leading him to coöperate heartily in all the efforts made for the restoration of his health.

CHAPTER III

THE ARMAMENTA

The word *armamenta*, sanctioned by long usage, is the most convenient term to designate the material equipment of the specialist, as its signification includes instruments, drugs, apparatus, furniture, everything indeed required for both diagnosis and treatment. In selecting the articles, two needs should be borne in mind: First, the need of those things, which will be demanded in the event of an emergency; such as syncope, or profuse hæmorrhage. Whatever else is lacking, these articles must be at hand; for their absence may mean a catastrophe. The second need is for the things most frequently employed in the diagnosis and treatment of the common diseases; those which make up the bulk of every practice, unless it is of a very unusual kind, work which constitutes what may be called the daily routine. The man, who is not supplied with these, will be constantly embarrassed and at a great disadvantage when compared with his competitors.

Whether the beginner's outfit should go beyond the supply of these two needs is partly a matter of individual taste and partly a question of financial ability. Any considerable surplus should be avoided. Money spent for unused instruments is a wholly unproductive investment and, while some patients may be favorably impressed by an extensive display of apparatus, the effect upon others is just the reverse. The following list is intended to include the armamenta required by emergencies and by routine practice, leaving some special contrivances to be described in connection with the operations for which they have been devised.

The patient's chair, shown in Fig. 2, should measure about eighteen inches from the floor to the seat; the back should extend eighteen inches and be surmounted by a head rest ten inches high. Its four essentials are that it should stand firmly upon the floor; that it should rotate freely and noiselessly at the level of the seat; that the back should be quickly made

FIG. 2.—The patient's chair.

horizontal, putting the patient in the recumbent posture; and that the head rest should be adjustable to a horizontal plane. without disturbing the back. Many models of such a chair are on the market. The one which provides these essential features by the simplest and plainest construction is the best. In this and every other article, avoid what is complicated and

ornamental. What is simple is least likely to get out of order, is most easily repaired, when it has been damaged, and is most readily kept clean and aseptic.

The surgeon's stool is plainly constructed of hard wood with four stout legs and a circular seat, to which both rotation and perpendicular movement are imparted by a metallic screw eight inches long. It is better to bring the operator's hands to the proper level with the patient's ear, nose or mouth, by raising or lowering the seat of his stool, than by making any change in the patient's position. The cabinet for instruments should be large enough to accommodate the articles without crowding. Both the doors and shelves should be of glass, so that dust or dirt of any description may be readily detected and removed. As there is seldom need for haste in replacing metal instruments upon the shelves, the danger of breaking the glass is slight.

The instrument table holds those implements needed in the procedure under way and also the drugs required for anæsthesia, for checking hæmorrhage, or any other purpose connected with the particular work in hand. It brings within the surgeon's reach what he needs in treating the patient then before him. For that purpose it is very convenient and almost essential, and to that purpose it should be restricted. It is bad practice to encumber the table with articles left after previous operations, with books or, indeed, anything except the few necessaries required by the work of the hour. If the table is encumbered by extraneous things, it loses half its value, which consists in momentarily offering to the operator just the things he wants and nothing else. Restricted to such proper use, the table need not be large and the smaller the area occupied by instruments, the surer one is to grasp quickly the article needed.

This table should be supported by four smooth, cylindrical legs of ample strength to insure stability and its top should be a round-cornered rectangle, each side of which measures from eighteen to twenty inches. Glass is scarcely a suitable material

for this top, because metal articles may be dropped upon it with some force and a fracture of the glass is a costly accident, and may also greatly disturb a nervous patient. Marble is easily spoiled by eroding chemicals, which may be accidentally spilled. A satisfactory material is oil-finished oak, and perhaps even a better is a slab of slate, a substance which resists most chemicals and is much less likely to break superimposed glass vessels than is either metal or marble. One or two additional chairs may be needed. For aseptic reasons they should be free from cracks and crevices, also from cushions and upholstery of every sort.

The washstand should have a flow of both hot and cold water. This is readily available in most cities and towns. When the office is in a house, whose water-heating apparatus cannot be relied on, the defect can be overcome by interposing a gas-heated coil in the course of the service pipe. A fountain cuspidor, which can be kept clean at all times, should be connected with the pipe giving drainage to the washstand.

A three-leaved toilet mirror, fastened to the wall above the washstand, will prove convenient to lady patients in adjusting their head wear.

In a corner of the office may stand a plain cabinet of some hard wood, finished with oil. Its height should be about three and a half feet, its length two feet and its depth one foot and a half. A swinging door of wood held by a simple catch, not lock, should occupy one of the longer sides. The lower part of the inclosed space should accommodate a pail of agate ware or similar material serving as receptacle for soiled gauze, cotton and detritus of every sort, except what is washed away in the fountain cuspidor and basin. Above this should be placed two shelves, not drawers, to hold towels, napkins and various articles unsuited for a place behind the glass doors of the instrument cabinet. The protection of the clothing of patients can be effected at the smallest cost by adjusting under the chin a Japanese paper napkin retained by a neck band of white tape a foot long, upon each end of which is sewed one of those

little clamps used in elastic garters to grip the upper margin of the half-hose they support.

The firm and level top of this cabinet is a good situation for the sterilizer. This is virtually a vessel in which instruments are subjected to the aseptic influence of boiling water. In its conventional form, as furnished by the instrument makers, it is a rather costly machine to accomplish a very simple purpose; but the use of this type is so widespread that its purchase seems expedient. The required heat may be produced by burning oil, or gas; but it is better to use electricity, if available.

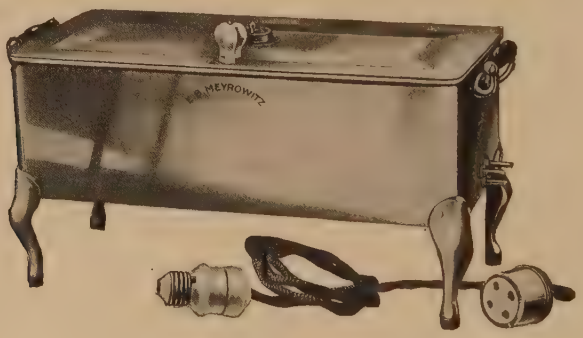


FIG. 3.—The electric sterilizer.

The electric sterilizer, illustrated in Fig. 3, is a rectilinear vessel of sheet copper furnished with nonconducting handles and having the legs tipped with porcelain. A tray, holding the instruments to be boiled, rests upon supports within the receptacle and can be lifted out of the water, when the exposure to high temperature has been long enough for thorough sterilization. This immersion in boiling water should last ten or twelve minutes and the instruments should then be wiped thoroughly dry, for if they are replaced in the cabinet while moist, burnished steel surfaces may in a few hours be damaged by rust.

A good artificial light is indispensable and its first requisite is a satisfactory bracket, which combines strength and stability and has both perpendicular and horizontal motion. Fig. 4

shows a bracket lamp which has the necessary features. The metal retaining plate on the right is to be securely fastened to the studding of the wall, or some other firm support. Through this plate pass the electric wire and gas pipe which extend through the two sections of tubing. The joint close to the retaining plate and a second joint, at A, impart to the tubes both a vertical and a lateral motion, so that the lamp may be adjusted to any position desired. This bracket should be so located that the patient's chair may be brought close to it and, as it will be used continually, it should be very strongly made: weak joints soon get out of order. The material employed is

FIG. 4.—A bracket lamp.

generally bronze or gun metal. At the end of the tubing, on the left, is the lamp, which may be gas or electric, the latter being preferable since it gives less trouble and radiates but little heat. To the lamp should be attached a Mackenzie condenser, to concentrate the rays of light.

The head mirror (Fig. 5) to reflect light upon the place under inspection is circular, slightly concave, and has in the center a hole which is kept directly over the pupil of one of the physician's eyes. The diameter of this hole should not be more than three-eighths of an inch. This mirror is supported by a head band, best made of a single piece of sheet metal

sufficiently resilient to remain steady, but not making undue pressure. The mirror should have a focal distance of about seven inches and a diameter of three and a half inches.

The electrocautery is much less used than formerly, but is still employed in treating tubercular growths and dilated blood vessels. It has the advantage that the loop or cone can be introduced and also withdrawn cold, the high temperature lasting only while there is a closed circuit. Its current can be

Fig. 5.—The head mirror.

supplied by a storage battery, or derived from the ordinary house wiring by employing a modifier.

Compressed air is useful for so many purposes that it should be at all times available. There is need for a machine operated by some readily applied power, and which will work automatically. This machine should be capable of furnishing air in ample amount and under sufficient pressure to meet all probable requirements, and its construction should be such that it will not readily get out of order and that it can be bought at a moderate price.

The IXL Automatic Air Compressor, shown in Fig. 6, with the addition of a reservoir similar to the galvanized iron boilers attached to kitchen ranges, has proved, in my experience, a practicable and durable machine and its cost is not prohibitive. Its motive power is derived from the flow of water in the service

pipes which are connected with the water main in the street and, in residential houses, it is commonly placed in the cellar, whence a pipe conveying the compressed air leads up to the office. In the upper stories of very high buildings, the remoteness of the cellar makes this plan expensive and the apparatus

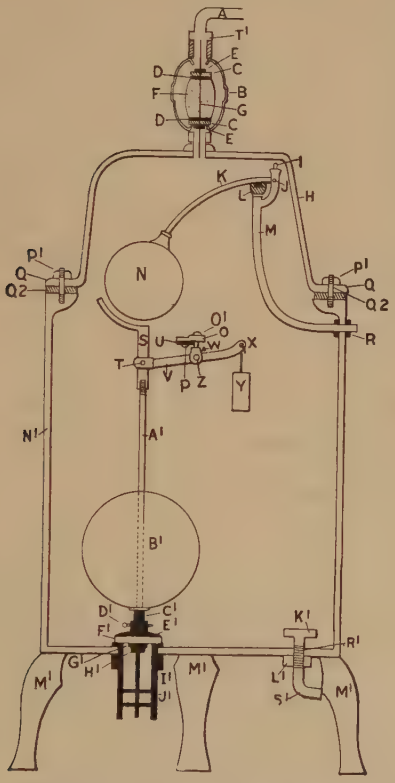


FIG. 6.—An automatic air compressor.

should, if possible, be accommodated upon the same floor with the office. The IXL compressor requires little attention and rarely gets out of order; it is not clogged by muddy water and does not need hand pumping to start the machinery. It gives one pound of air pressure for each pound of water pressure, and as soon as the pressure in the reservoir falls below a designated

minimum, the hydraulic motor starts automatically and the pressure is increased. The maximum pressure in city water mains is much greater than can be used with safety in many of the cases where compressed air is employed, and the office should contain a mechanism for reducing and regulating the force. A device of this kind (Fig. 7), which is simple and durable, can readily be procured. It is furnished with a gauge showing the exact pressure under which the air passes into the delivery tube and, by the turn of a single thumb screw, this pressure can be regulated with entire accuracy. This delivery tube is furnished with a closure valve very near the end which connects with the atomizer, and by this valve the air current can be immediately cut off. In addition to apparatus of this sort, the physician should have a small and simple hand pump, as a resource in case of any accident to the machine or its pipe connections.

FIG. 7.—Regulator of air pressure and gauge.

FIG. 8.—The ether vaporizer and air comminutor.

The apparatus for ether-vapor anæsthesia, including the intratracheal (Fig. 8), consists of a jar partly filled with

ether and standing in a vessel of hot water. The vapor mingles with a current of air passing through the upper part of the jar, the proportion of each substance being regulated by stop-cocks. The mixture is carried to the patient by a flexible tube. The air which comes from the compressor, at a density indicated by a pressure gauge, is passed through a Wolff's wash bottle; but when the air is forced through this bath in large bubbles, they retain dust and motes which have not been given time to sink. A more efficient device for cleansing is the air comminutor—a large glass jar (Fig. 8) almost filled by fragments of aseptic cotton loosely arranged. The air entering at the bottom of the jar is subdivided into minute jets by a circular sheet of fine wire gauze and then in traversing the mass of cotton deposits the solid particles it has borne along and, when it emerges through the exit tube at the top of the jar, it is almost entirely clean.

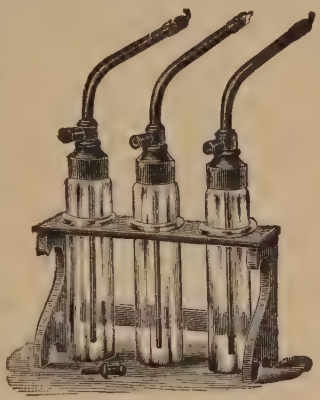


FIG. 9.—Davidson hard-rubber atomizer.

When it is desired to convert a liquid into the form of spray, the nebulizing is effected by driving a rapid current of air across the orifice of a capillary tube. The instruments invented for this purpose are almost numberless, but for the usual office work a Davidson hard-rubber atomizer will be found sufficient (Fig. 9).

The vacuum aspirator consists of a jar from which the air is partly exhausted by a hand suction bulb. To this is attached a rubber tube connected with an aspirating needle. It is used to withdraw liquids, serum, pus, etc., in cases where a free incision is objectionable.

The insufflator is a contrivance for scattering powders, such as bismuth subnitrate, over surfaces like those of the

nasal cavities. The medicament is carried by puffs of air impelled by a rubber hand bulb (Fig. 10).

The so called nasal douche, which sent a jet of water up one of the nostrils to return by way of the other, or to run into the pharynx, was a dangerous instrument, as the injected liquid mixed with purulent secretions was liable to enter the Eustachian tube and carry infection to the middle ear. If we wish to use in the nostrils a very gentle stream (and none other is allowable in either the nose or the ear), the bulb syringe made entirely of soft rubber and one ounce in capacity is the best device for the purpose.

Fig. 10.—The insufflator.

Of the various nasal specula, the Ingals and Bosworth have given me the most satisfaction. In aural specula my preference is for those of the Gruber type (Fig. 11). They come in sets of three or five, giving a proper

Fig. 11.—Gruber aural specula.

assortment of sizes. They are elliptical in cross-section, corresponding to the form of the meatus, and are made of highly polished metal.

It is necessary to have forceps, shaped for use in the nose, ear and larynx, adapted for seizing and removing foreign bodies and for applying dressings. Cutting forceps are necessary for the removal of polypi. Mackenzie's laryngeal forceps and the Tobolt laryngeal probe are useful instruments. Aural and nasal applicators are shaped much like a probe and have the distal end somewhat roughened to give a hold upon cotton or other fibrous substance wrapped around it. An

applicator with a corkscrew end is convenient when one wishes to carry a pledget to a certain spot and leave it there, for by turning the applicator from right to left, it is easily disengaged. The point of the screw must be very blunt, to avoid harm from a turn in the wrong direction.

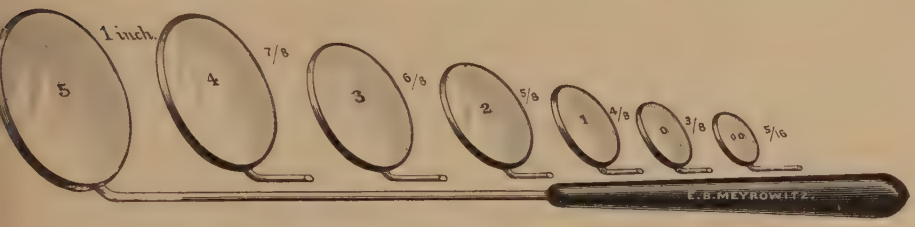


FIG. 12.—Laryngoscope handle and assorted mirrors.

The laryngoscope consists of a set of circular mirrors of graded size, each being attached to a short wire shank. These shanks fit into a common handle of polished metal, to which they can be securely fastened by a set screw. The size of the mirror used depends wholly upon the circumstances in each case examined (Fig. 12).

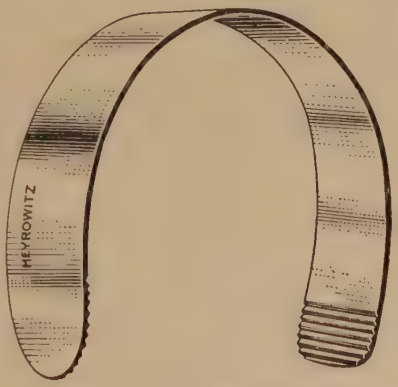


FIG. 13.—The tongue depressor.

The tongue depressor is designed to hold the tongue in its natural posture while at rest, when it fills the elliptical cavity bounded by the curve of the lower jaw. Very little pressure should be put upon the tongue; it should simply be restricted to its horizontal position, so as to permit an unobstructed view of the fauces and the organs posterior to it. One of the simplest and best instruments for this purpose is a semicircular band of metal (Fig. 13). The ends have an elliptical curve and both are corrugated on the inner surface, giving a hold upon the tongue and a good grasp for the hand.

The Politzer air bag (Fig. 14), a rubber bulb of pyriform shape with a flexible tube terminating in a nose-piece, is frequently used for inflating the Eustachian tube. The bag should have a capacity equal to eight fluidounces of water; smaller sizes are not efficient. Sometimes the air expelled

Fig. 14.—The Politzer air bag.

from the bag passes without difficulty through the Eustachian orifice and hence along the tube to the middle ear. In other instances it is necessary to employ a Eustachian catheter. The best material for this instrument is pure silver; it is softer than the alloyed metal and a catheter made of it can be bent

Fig. 15.—The auscultation tube.

at any curve and will retain that shape, while many other flexibles spring back to their original shape. In judging by sound whether the injected air has actually reached the middle ear, the auscultation tube is useful. It is simply a rubber pipe about two feet long fitted at the ends with a white and

a black ear-piece. One of these rests in the auditory meatus of the patient, the other in that of the surgeon, and when the air reaches the middle ear, its entrance is distinctly heard (Fig. 15).

Siegle's pneumatic otoscope (Fig. 16) is an instrument of conical shape having at the base a magnifying lens and

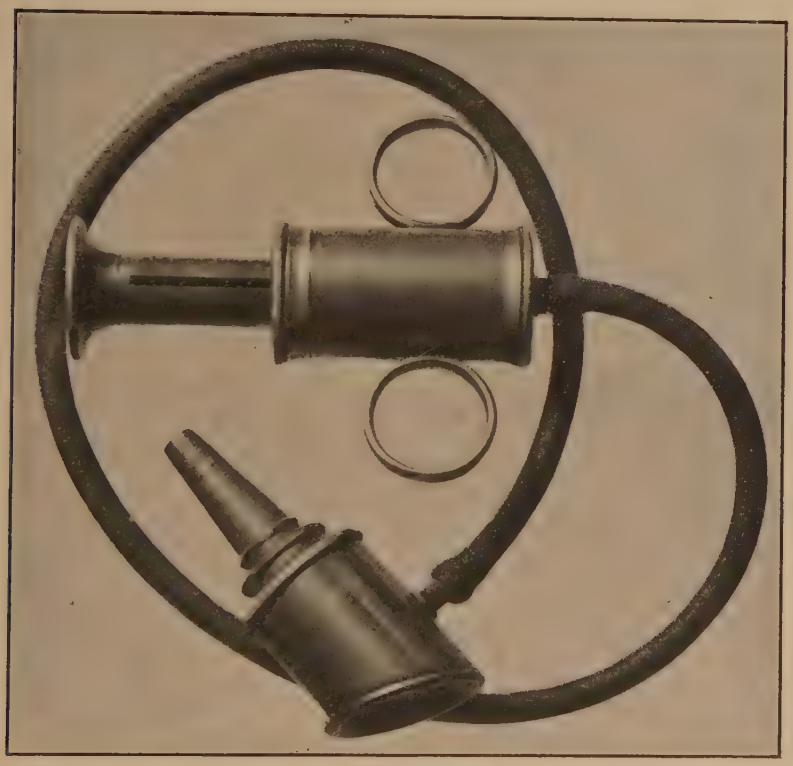


FIG. 16.—Siegle's otoscope with the Delstanche masseur.

at the apex an elastic ring which so fits the meatus as to render it a closed chamber, in which the air is condensed or rarefied by the action of a hand bulb. This instrument is improved by replacing the bulb by Delstanche's masseur, a small piston pump which always produces suction, thus rarefying the air

in the external ear and drawing the drum membrane outward. When air is allowed to reënter, the membrane retracts by its own elasticity. This to and fro movement has been called "massage of the ear drum." It is useful in both diagnosis and treatment.

There are two instruments constantly employed for testing the hearing and for making differential diagnosis when it is impaired. One is Dench's modification of the Galton whistle (Fig. 17). It is inexpensive and not easily injured and gives with accuracy the tone for which it is adjusted. This whistle is made upon the principle of a closed organ pipe and its pitch extends through several octaves, ranging from about

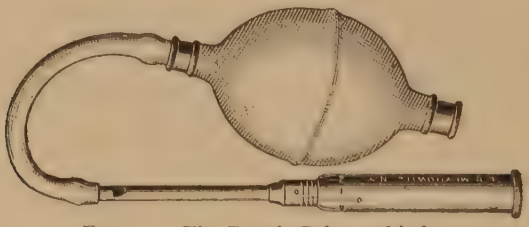


Fig. 17.—The Dench-Galton whistle.

1700 (1677) vibrations, per second, to 40,000. As the instrument is seen in the shops the current of air is produced by an atomizer bulb with valves at the orifices. This is objectionable, for the movements of these valves produce extraneous noises, rendering the primary tone impure. This difficulty can be removed by substituting the valveless, soft-rubber bulb of the aural syringe.

Another important instrument is the tuning fork. This has been long used by musicians because it is almost indestructible and always gives forth an unchanging tone. For otologic purposes tuning forks are commonly furnished in sets of five. In each set there is one which gives 256 double vibrations per second, producing a tone of the same pitch as belongs to the middle C upon the keyboard of the piano. On this account the figures 256 are often inscribed upon this fork. The other

four produce higher or lower tones, separated by intervals of one octave, and their vibratory numbers are obtained by using two as a divisor (128) or as a multiplier (512, 1024, 2048, etc.). Dr. Randall's forks (Fig. 18) are the most satisfactory, as they have been continually improved until, in their pres-

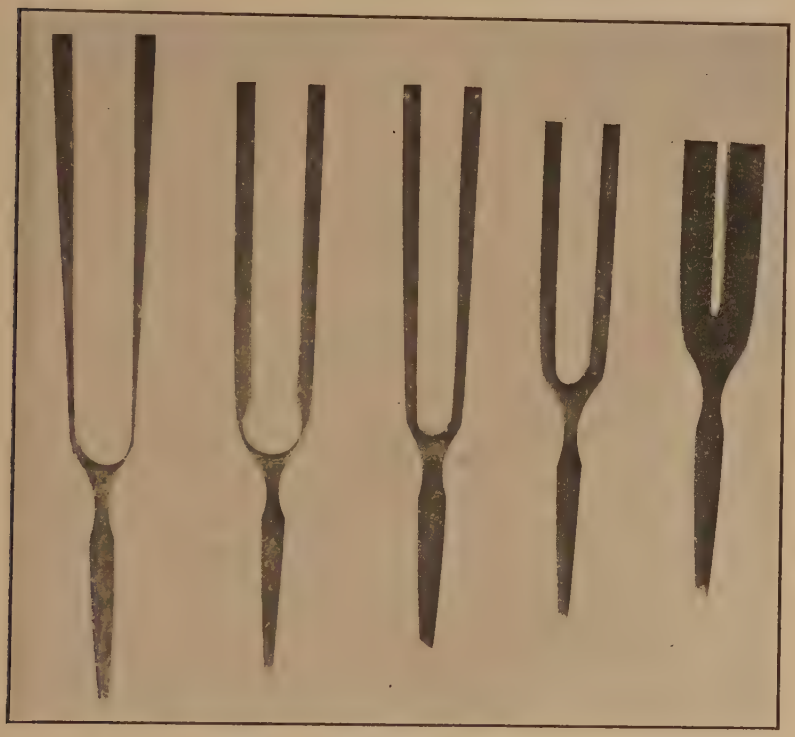


FIG. 18.—Randall's tuning forks.

ent state, overtones are nearly eliminated and that too without adding to the prongs metal bands or any other attachment.

Hæmostats and artery forceps are a necessary part of the instrumental equipment as also is a good hypodermic syringe, whose needles should be short and of rather large lumen. Long needles are liable to bend in penetrating the skin and a minute bore is readily clogged.

There are three aids to diagnosis so universally used that every physician is presumed to possess them, whether he is or is not a specialist. These are the clinical thermometer, the stethoscope and the sphygmomanometer. They are too familiar to require description, but it should be said that attention has recently been drawn to the great significance of blood-pressure tests in tonsillitis, which is so often an etiological factor in nephritis. The rapidly rising blood pressure is often the first recognized signal of the intercurrent renal disease.

It appears unnecessary to occupy space by a description of the scalpel, bistoury, probe and other articles included in the pocket surgical case. This small assortment of necessary instruments is familiar to almost every graduate long before he takes up the study and practice of any specialty. Need for their use may occur at any time in almost any office.

In accordance with the purpose expressed at the beginning of this chapter, the list of remedies here given includes those employed in the usual routine of practice and those needed in emergencies and which should be instantly available in a form to produce immediate effects. Other valuable medicines will be considered in connection with the diseases to which they are applicable. Liquids injured by light are best kept in cylindrical phials of clear glass inclosed in dark-colored cartons, which leave the glass stopper protruding. These phials are better than those made of blue or other opaque glass, because the quantity and condition of the liquid can be inspected by withdrawing the paper cover, which also protects against breaking.

The need for very prompt action is usually the reason for giving a hypodermic injection, and this need requires that the remedy should be in the liquid state and readily absorbable. Nevertheless, many men have discarded hypodermic solutions and depend upon the tablets which, though soluble, necessarily involve delay. They have submitted to this delay because of the frequent and serious mistakes occurring with solutions of the dangerous alkaloids. Both danger and delay can be wholly avoided if the physician makes his own solutions in the

following way: Decide upon a standard dose of each alkaloid, a beginning dose safe for immediate injection; dissolve twelve tablets of this strength in half a fluidounce of water C.P. and filter the solution into an ounce bottle, wide necked and glass stoppered, upon which is gummed a plain label bearing the name of the medicine and the dose. When the injection is required, fill the hypodermic syringe directly from the bottle and administer its entire content, assumed to be twenty minims, as this is the usual capacity of the stock syringe upon which this calculation is based. Suppose the substance to be sulphate of morphia and the standard dose one-fourth grain. If to twelve tablets half a fluidounce, or 240 minims, of water has been added, twenty minims, or the content of the syringe, will contain a quarter grain of the drug. Just so in every other case; when the syringe is filled by suction from the bottle holding the solution, the syringe contains the exact standard dose of the intended remedy in a form adapted to immediate absorption. The only things to remember are the standard doses and the fact that a syringe full always represents them. There is scarcely a possibility of error. Besides sulphate of morphia, there may be needed for hypodermic injection sulphate of atropia ($\frac{1}{100}$ grain), sulphate of strychnia ($\frac{1}{60}$ grain) and digitalin, not digitoxin ($\frac{1}{10}$ grain).

Ammonia is a powerful cardiac stimulant and, as it is freely evolved from the stronger water of ammonia, this solution should be kept in a small, rubber-stoppered phial. If syncope occurs, three or four minims should be dropped upon a fragment of cotton or gauze, which should be held near the patient's nostrils—a much safer plan than holding the open bottle to the nose.

Alcohol is astringent, antiseptic and stimulant. For the last-named purpose it is given by the stomach, and this organ is more tolerant of the liquors produced by distillation than of synthetic solutions made by mixing alcohol with water and other substances. Genuine brandy, that is, the distillate of pure grape wine, is the ideal diffusible stimulant. In the treatment of

shock its superiority over other alcoholics is so manifest that I believe it influences metabolism in some way they cannot. Unfortunately, genuine brandy is costly and fabricated substitutes are so common that the real thing is hard to procure at any price. As a diffusible stimulant, its place is best supplied by a pure, well-matured whiskey made from rye. Of this an eight ounce bottle should be kept on hand.

For use as an astringent in otitis media and other cases it is not necessary, as some authors advise, to keep four or five dilutions of pure alcohol. This encumbers space with too many bottles. Four ounces of the spiritus rectificatus of the pharmacopœia (sp. gr. 835), which contains sixteen per cent. water, is sufficient, as any dilution wished for can be readily made by adding distilled water, which mingles at once with alcohol in all proportions and at all temperatures.

To stop bleeding our main reliance is upon ligatures, packing and cold, but oozing from capillaries may be controlled by remedies which coagulate the albumen of the blood. Sodium perborate is one of the best. It is a powder which upon the addition of water generates peroxide of hydrogen. Applied to a bleeding spot with a moist pledget of cotton upon the tip of an applicator, it almost immediately causes coagulation. If a vegetable styptic is preferred, tannic acid, eight per cent. in glycerine, can be used with a similar instrument.

A two ounce bottle of each of these drugs should be provided and others are scarcely needed, as these meet the indications for hæmostatic remedies.

To produce ischemia or blanching of the tissues, chloride of epinephrin is very efficient; but its effect soon disappears and the constricted arterioles regain their usual size. An ounce phial of the common solution, one part to a thousand (1 : 1000) is a sufficient supply since exposure to the air causes a decomposition, marked by a change in color, and a part of even the small quantity mentioned may require to be thrown away. The ratio, 1 : 1000, gives a stronger solution than is

usually necessary and this may be diluted, when used for spraying, to the proportion of 1 : 10,000.

Astringents of many kinds are in use to meet certain indications in various forms of relaxation; but the following are sufficient for habitual employment. The familiar tincture of the chloride of iron has, in addition to astringency, an alterative influence upon the mucous membrane. It should be applied with a cotton wisp, to be rejected immediately afterward, as it attacks brushes, corks, and most metals. Care should be taken to prevent its touching the teeth, since it rapidly destroys their enamel.

Guaiacol in proportion of two fluidrams to six of pure, fresh, olive oil may be applied by a swab in pharyngeal and tonsillar inflammations. The compound tincture of benzoin is a mild astringent applied in a similar way, particularly in sub-acute and chronic inflammations.

Chemical caustics can be employed for the same purposes as the galvanocautery, if the office is not provided with the electrical appliances. A fused bead of chromic acid adherent to the end of a probe is drawn lightly over the surface to be affected, so that contact is made in parallel lines very near together. The acid withdraws all water from the superficial layer of tissue, thus devitalizing it. Chromic acid should not be applied to a large area at one time, because if absorbed, it may injure the kidneys.

Nitrate of silver varies in effect from a mild stimulant to an escharotic, in accordance with the strength of the solution used. This remedy should be kept in two bottles, glass stoppered and protected from light. The first should contain ten grains of the crystalline nitrate in one fluidounce of water, this giving very nearly a two per cent. solution, applicable in all instances where a mild effect is in view. In the second bottle should be put 360 grains of the silver salt with enough water to make one fluidounce, producing a seventy-five per cent. solution capable of the stronger action of the drug. This strong liquid coagulates albumen, closes the blood and

lymph passages and, in general, does the work of a caustic. Solutions to produce intermediate effects are readily prepared by adding water to the strong fluid, *e.g.*, one part of this plus two parts water gives a strength of twenty-five per cent., very useful for some purposes. Caution should be observed in applying silver nitrate to the throat that none of it drops upon the larynx to which it is injurious, hence the cotton wet with the solution should be securely held by the applicator and all superfluous liquid be absorbed by a pad, before the throat is treated. Another caution is to avoid the solid stick of fused nitrate, which though valuable for some purposes, is dangerous in nose and throat work. There is risk that the stick may be broken, or may slip out of the caustic holder and a fragment drop into the œsophagus or, much worse, into the trachea.

Carbolic acid is a very efficient drug where we desire a diffused and superficial cauterization. It does not penetrate deeply and causes hardly any pain. For this use as a caustic, the pure crystalline phenol should be employed with the addition of just enough glycerine to liquefy it. In this strength the acid is safer than when diluted, as the escharotic action prevents absorption.

Detergent applications are required in many instances to remove crusts, pus, adherent dust and other impurities. They should be used gently, for the purpose is not to scrub the mucosa, but to soften and loosen the accretions which will then be easily removed. Inspissated pus is rapidly decomposed by the peroxide of hydrogen, which should be diluted with an equal quantity of water, if the solution on hand is the three per cent. combination usually sold. This drug should not be sprayed and it should be allowed slow action, a little at a time, so that there may be but slight frothing. This caution is specially necessary when treating the ear for the gas forcibly disengaged has been known to drive purulent particles into the mastoid cells.

Dobell's solution has a well-established reputation as a

cleanser of the nose and throat. It can be employed in full strength or diluted, and either as a spray or with a cotton swab. The formula is:

℞. Sodii bicarbonatis..... ʒj
Sodii biboratis..... ʒj
Acidi carbolici..... gr. xv
Glycerini..... fl ʒj
Aquæ distillatæ.....q.s. ad. Oij. M.

This remedy proves of most value in inflammations, which have reached a sub-acute or chronic stage. While the process is acute, better results follow the use of the normal salt solution. In many cases this is the best possible application and the fact that it is a constituent of healthy blood and most other somatic fluids often gives it an advantage over substances which are foreign to the organism.

Sprays of oleaginous composition do good by soothing and protecting irritated tissues. Camphor and menthol, in the proportion of two grains of each in a fluidounce of an excipient, make a useful preparation for routine work. The best vehicle for such drugs is the officinal petrolatum liquidum.

In idolent ulcers and wherever the reparative process requires stimulation an excellent application is the thymol-diiodide (aristol), a compound of iodine, which has largely superseded iodoform, long in general use. It possesses the advantages of being less toxic than iodoform and being free from that drug's very unpleasant odor. It may be used in its simple state as a powder, or made into a ten per cent. ointment, or dissolved in oil, in which it is quite soluble, although very little of it is taken up by water. Stearate of zinc is emollient and mildly astringent. For external use it is free from danger; it produces no stains and is wholly odorless. Subnitrate of bismuth sprinkled upon surfaces, denuded by operation, forms a mechanical shield which is protective and somewhat sedative. Calomel may be used for the same purpose. These powders, being insoluble, should not be allowed entrance to narrow passages or cavities difficult of access. If a dry powder is

wanted in such situations, borax and boric acid, which are easily dissolved, are much safer.

Local anæsthesia is of very great importance in laryngological practice, not only as an essential condition in many operations, but to reduce the discomfort often attendant upon diagnostic procedures and also as a factor in the therapeusis of some diseases. There are two drugs capable of producing this condition which should be kept ready for use viz: solution of cocaine hydrochlorate and solution of novocain. Their dosage and mode of action is similar but the novocain is far less toxic and is to be preferred in patients who have an abnormal susceptibility to cocaine. Accidents from local anæsthetics are far less frequent in our work than in general surgery, because we apply the drug to the mucous membrane, which slowly absorbs it from cotton or some other fabric soaked by the solution; hence if some untoward symptom appears, when only a small fraction of a grain has been taken up, the balance of the dose can be withdrawn. This opportunity does not occur when, as is common in other regions, the entire dose is given in one hypodermic injection. It will be advisable to keep on hand a one-ounce bottle of each anæsthetic, the solution being made by dissolving twenty grains of the salt in a fluidounce of water, with the addition of five grains of antipyrin as a preservative. These are practically four per cent. dilutions and are efficient, if enough time be allowed for absorption by the mucous membrane. The addition of a few drops of the solution of epinephrin chloride already described will promote ischæmia and lessen the reaction liable to follow the use of local anæsthetics. Though the procedure here outlined is attended by little danger, the surgeon must bear in mind that twenty-five minims of the solution contain a grain of the principal drug which, if it be all absorbed, is a full dose. If the application is made slowly, a less quantity will generally produce the local effect desired. For employment as a spray, the four per cent. solution should be diluted with an equal quantity of water.

CHAPTER IV

THE NASAL SEPTUM

In Chapter I, the Scope of Laryngology, attention was directed to the paramount importance of the two great passageways which traverse the naso-pharyngeal region—the breath-road and the food-road. Their occlusion is fatal and their obstruction, in even a slight degree, is seriously detrimental, such obstruction of one or the other constituting the common factor in most of the diseases we are called upon to treat.

The normal course of the breath is through the nostrils, the route by way of the mouth being supplementary. In traversing the curved passageways, from the nasal vestibule to the pharynx, the inspired air is warmed, moistened and, in slight measure, filtered, some of the solid particles it carries being caught by the vibrissæ, the hairs within the vestibule, while others are entangled by the viscid mucus bathing the irregular surface of the walls. When one finds it hard to breathe through the nose he opens his mouth, thus utilizing the supplementary oral route, but upon this route the warming and moistening of air are done very imperfectly and the filtering not at all. This deficiency in preparing the atmosphere before it goes to the lungs is the first evil in a long train of injurious effects dependent upon mouth breathing, if that substitution of the supplementary route, in place of the nasal breath-road, becomes a permanent practice.

Much time and ingenuity have been devoted to differentiating the various nasal obstructions to determine whether they interfere chiefly with inspiration or with expiration. This is a refinement of little practical utility. If the mouth is opened to assist one-half of the respiratory act, it will remain open during the other half and, if the need for assistance continues,

the habit of mouth breathing will be acquired. It matters little whether the original difficulty was with inspiration or expiration.

The two parallel passageways of the nose may be narrowed at any point and the encroachment may come either from their outer walls or from the partition by which they are divided. This partition, called the septum, has an important place in

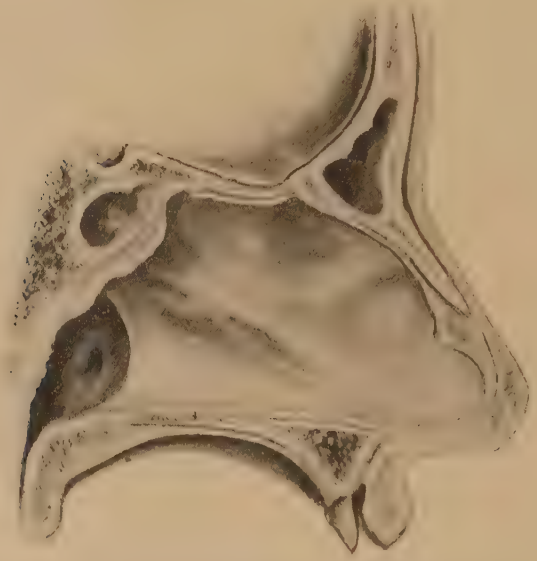


FIG. 19.—The nasal septum with mucous membrane intact.

rhinological surgery, as morbid changes in its shape are responsible for much obstruction and they frequently require operative correction.

The septum is formed by the perpendicular plate of the ethmoid bone above and the vomer below, with the addition of the septal cartilage. In articulating with each other, the two bones leave toward the front a triangular space, and this is filled by the cartilage which gives to the septum the shape of an unsymmetrical square plate with irregular margins and standing in a perpendicular position above the arch of the hard palate.

Upon each side of this plate the periosteal layer is covered by a network of blood vessels, lymphatics and nerves; the interstices are filled by connective tissue and over all are the submucous and the mucous membrane which here has a stratified, ciliated epithelium whose function should be preserved. In the layer composed of the submucous and mucous membranes, secreting glandules are very abundant. Terminal filaments of the olfactory nerve are distributed over the upper third of the

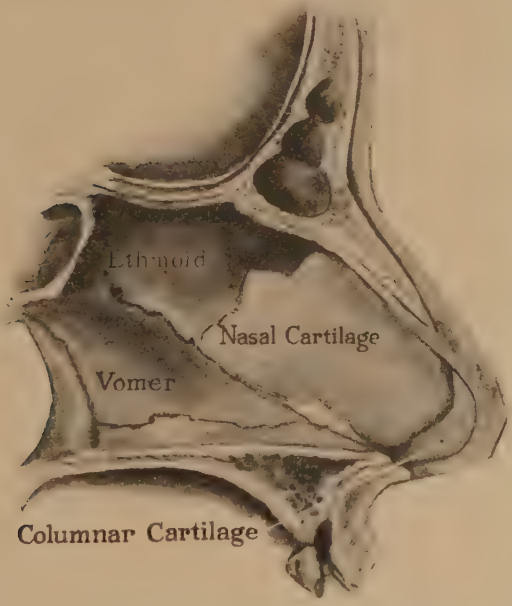


FIG. 20.—The nasal septum with mucous membrane removed.

septum; its other nerves also are sensory and are branches of the anterior ethmoid and the naso-palatine; its arteries are derived from the anterior and posterior ethmoid and the posterior nasal. There are no muscular attachments. The septum with and without its mucous membrane is shown in Figs. 19 and 20.

Morbid conditions of this structure include malpositions and malformations, the former often causing or increasing the latter,

since a marked deviation almost always produces unequal curvature of the two sides, with thickening and other changes. Following the plan of etiological investigation laid down in Chapter II, we inquire whether the morbid state of the septum is (1) congenital, (2) due to traumatism, (3) caused by foreign bodies, (4) caused by micro-organisms. The third question may almost certainly be answered in the negative, as this thin plate with a fossa on either side can scarcely furnish a hiding place for any extraneous body; nevertheless, the careful surgeon will scrutinize both surfaces and, if there be any suspicious appearance, will examine the spot with a probe, either bulbous, or sharp-pointed.

There is general agreement that marked or harmful deviations of the septum are rarely congenital, but very frequently developmental. In childhood the roof of the hard palate curves more sharply than in adult life and has been called the "Gothic arch." Normally this arch flattens with further development and in so doing gives room for the downward growth of the septum, but sometimes this flattening does not occur and then the septum, deprived of necessary space for proper extension, suffers a deviation and bulges laterally into the right or left fossa. Any diathesis, which impedes the normal development of the bones, may affect the ethmoid and the vomer and produce septal deformity (see Fig. 20).

Traumatism accounts for many cases. Although the septum is less exposed to external violence than the symphysis of the nasal bones, constituting the bridge of the nose, yet the triangular cartilage is liable to be injured by transmitted force (counter stroke) without a surface wound and, of course, may be damaged to any extent by accidents which lacerate the tissues.

Infections produced by micro-organisms may, by long-continued action, induce trophic changes leading to various sorts of deformity. These infections will be considered further on. In so far as they have caused structural alterations in the septum, such deformities generally require the same

treatment as though they had a developmental or traumatic origin but it must be borne in mind that the prognosis of operations may be influenced by the basic infection, which may have impaired the vitality of the tissues, so as to make recuperation after surgical operations slow and imperfect.

There is an important relation between septal abnormalities and catarrhal rhinitis. They have reciprocal etiologies; prolonged inflammation produces hypertrophy and deformities; on the other hand, structural changes, by impeding respiration and by the harsh efforts patients make (picking, douching, blowing) to relieve their discomfort, bring about chronic inflammation. When the two conditions coexist, as they usually do, our efforts should first be directed to the rhinitis and the appropriate remedies described in Chapter VII should be faithfully applied and only when they have failed should other procedures be undertaken. In many cases, after the patient has been cured of the rhinitis it is found that all the symptoms are so much ameliorated that it is not necessary to go further.

This conservative method has encountered the criticism that, as deformities may cause rhinitis, any relief from it while the deformities remain will be of short duration and very slight advantage, a mere trivial palliation. The objection is not well taken, as appears from instances where the disease has an occupational origin. A man has a septum which is somewhat deflected but has given no trouble. He engages in work of an unhealthful kind and is attacked by rhinitis leading to septal hyperplasia and deformity; he withdraws from the injurious vocation but continues to suffer from the combined diseases. He now comes under treatment and is cured of the rhinitis, slight deformity remains, together with the original deflection, but there is plenty of room for respiration and the obstructive symptoms disappear and do not return. The reason is plain. The rhinitis had been caused by the joint influence of the anatomical abnormality and the injurious vocation: the second factor having been removed,

the structural fault could not alone cause a relapse. Even in instances where cure of the rhinitis does not adequately relieve all the symptoms, it is of great advantage as a preliminary to the doing of any corrective operation.

Fig. 21.—Deviation of the septum with convex enlargement of the middle turbinal. The heavy line shows the section made by the saw, removing the bulge, before the septum is straightened.

Another matter should receive attention prior to any septal surgery. Not unfrequently there is upon the middle or lower turbinate bone a convex enlargement corresponding to a concavity upon the septum and between the two there is a curved passageway which, though of unnatural shape, still gives ample room for the movement of the air. If the septum is straightened it will impinge upon this convexity and close the breath-road upon that side, as shown in Fig. 21. When, therefore, such a bulge is found upon one of the turbinals, it should be removed under local anæsthesia with a Mial's saw

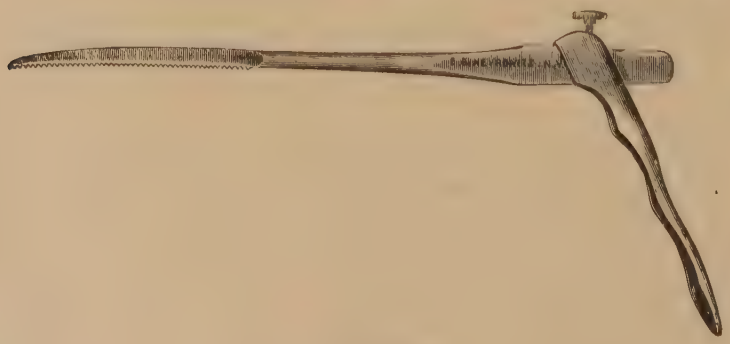


Fig. 22.—Mial's saw.

(Fig. 22) or a spokeshave, the section being made so as to leave a raw surface parallel to the plane of the septum after it shall be made straight. This raw surface usually heals readily by granulation.

Surgical correction of septal deviations and deformities makes use of osteotomy and chondrotomy, either one, or both in combination. These operations, when successful, yield good results, but they are attended by the risks incident to the removal of bone and cartilage in highly vascular regions and they require specially devised instruments and specialized skill on the part of the operator. They should not be performed in the presence of highly acute inflammation, or an actively infectious process, and are interdicted by any tendency to hæmophilia. Furthermore, it must be remembered that minor variations in form and position do not necessarily impair the usefulness of the septum; indeed, slight deviations and little rugosities are often observed in persons, whose respiration and cognate functions are entirely healthy. The mere fact that the septum is asymmetrical or slightly deflected does not justify surgical interference unless there exists, as a consequence, obstruction to the respiration, or some impairment of the drainage and ventilation of the nasal fossæ, or the accessary sinuses.

When it has been ascertained that there is a morbid condition of serious import, for which the septum is responsible, a very careful examination should be made to ascertain just what part of the septum is at fault; for it has happened, more than once, that operations have been performed without relieving obstructive conditions, and subsequently it has been shown that the cutting was done in the wrong place.

The precise place and character of the operation having been determined, the nostrils should be thoroughly cleansed with an alkaline solution and the patient placed in a suitable position, either the posterior recumbent posture upon a table, or the upright posture in the office chair whose back can be instantly lowered in case of threatened syncope. Anæsthesia of the septum should be induced by applying on each side a six per cent. solution of cocaine followed by a solution of epinephrin chloride whose strength is one to a thousand, use being made of a wet, but not dripping, cotton-tipped applicator and

the process being repeated, at intervals of a few minutes, until the mucous membrane is ischæmic and desensitized. If the deformity to be corrected is limited to the cartilaginous portion of the partition, it is more readily rectified than if the osseous part is involved, but the partially detached segment is harder to retain in its new post-operative position because the resiliency of the cartilage draws it toward its former place and it becomes necessary to use nasal tubes or splints to prevent movement of the deflected segment for several days, until union along the severed edges is secure. Displaced segments of bone generally hold their position without such support.

FIG. 23.—Operation for deformity of the septum. Heavy line shows proper direction of the saw: dotted line shows wrong direction.

The septal conditions requiring correction are either deformities such as spurs, ridges, etc., or deviations, both of these generally appearing in conjunction. The operations for the first group are simpler and safer than those for deviations and should have priority in time and choice. It often happens that after the thorough removal of these various hypertrophies the nasal functions are so much improved that further surgical interference is not required. Even where this favorable result is not attained, the situation is much simplified and the operation for the deviation is made less difficult by the correction of deformities already accomplished.

A spur or ridge, protruding from either side of the septum and encroaching harmfully upon the nasal fossa, as shown in Fig. 23, may be removed as follows: With a scalpel of short, convex blade, cut through the mucosa and submucosa, carrying the incision around the edge of the protuberance slightly above its base; turn back the membranes away from the excrescence with an elevator, until the white, glistening surface of the

cartilage comes into view. Then saw through the base of the spur or ridge, from below upward, keeping the saw parallel with the perpendicular plane of the septum, thus avoiding the common error of making the section at an angle diverging from the septum. Instead of the saw, a spokeshave may be used. It engages the protuberance in its fenestra and then brings its cutting edge into contact, when the handle of the instrument is forcibly drawn outward. After the removal is complete, the edges of the mucosa and submucosa will almost meet across the denuded surface, because the redundant membranes, loosened and turned back by the elevator, will nearly cover the space occupied by the base of the spur or ridge. The small sulcus remaining between the edges soon fills by granulation and the reparative process is generally complete in four or five days.

This wound should be thoroughly dried and covered with a thin layer of sterile gauze, which is then well moistened with collodion applied drop by drop from a pipette. The drying of this dressing seals the wound and fully protects it from secretions and discharges. The gauze should remain until it spontaneously separates from the healed surface.

Lateral deviation, causing a bulge upon one side with a corresponding depression upon the other, may be corrected by the flap or window operation; but if the convexity is due to thickening, so that the opposite side presents a level surface, this operation will not remove the obstruction, but will simply transfer it from one fossa to the other.

Briefly stated, this procedure is as follows: Make a flap, which is either rectangular or U-shaped and which includes the bulging part of the septum, by cutting from the convex side through to the other; three edges of the rectangle, or the curved line of the U being incised and the flap being attached by the remaining margin. The edge must be beveled so that the area of the flap is greater upon the bulging side than upon the other. Forcibly push the flap through the window, made by the incision, to the unobstructed fossa, where it will be retained by the beveled edge which raises the margin of the

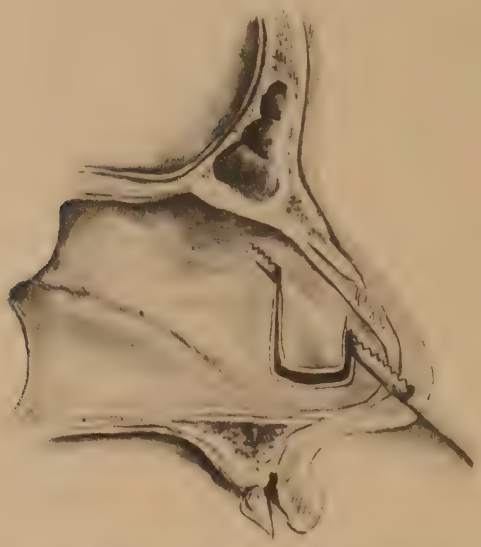


FIG. 24.—Flap operation upon the nasal septum.

FIG. 25.—Asch-Douglass operation upon the nasal septum. The heavy lines indicate incisions; dotted lines show fractures of the bases of the trianguloid segments.

flap somewhat above the level of the surface of the remaining part of the septum. Granulations will form along the margins of the flap and of the window and these will ultimately unite giving, in favorable cases, a nearly symmetrical septum which does not obstruct either fossa. If bony structure is included in the flap, it will be necessary to use a saw, as shown in Fig. 24.

When the deflexion is marked, a good operation is the Asch-Douglass shown in Fig. 25, which is done by applying the index-finger of the left hand to the convexity and cutting through the septum from the other side with a knife whose short, triangular blade is at right angles to its shank. This is called a button-hole incision and is made at the posterior margin of the deflexion. This perforation is extended by cutting with a curved, blunt-pointed bistoury forward from this point along the line of deepest deflexion to the anterior margin. Then starting at the deepest spot of the concavity the knife cuts along radii from this center choosing the lines of greatest deflexion. These incisions divide the cup-shaped deflexion into several trianguloid segments having their bases at the margin of the concavity and their apices at its center. Pressure is then made on the convex side, so as to fracture the bases of these segments, and force them across to the other side of the median line. If any other misdirected segments require rectification, they can be dislocated from their attachments with the Adams-Asch forceps, by a lateral rocking motion. After making as good coaptation as possible, Simpson-Bernay intranasal tampons (Fig. 26) are introduced to support the segments in their new position. Union along the edges usually takes place in a short time and, as soon as the danger of displacement is passed, the tampons should be removed and the surface lubricated with a bland, slightly alkaline ointment.

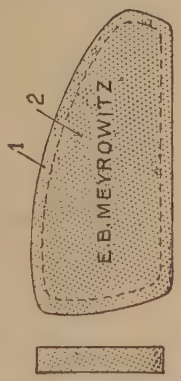


FIG. 26.—Simpson-Bernay intranasal tampons.

When no untoward interference occurs this operation gives a nearly straight septum with full restoration of functions.

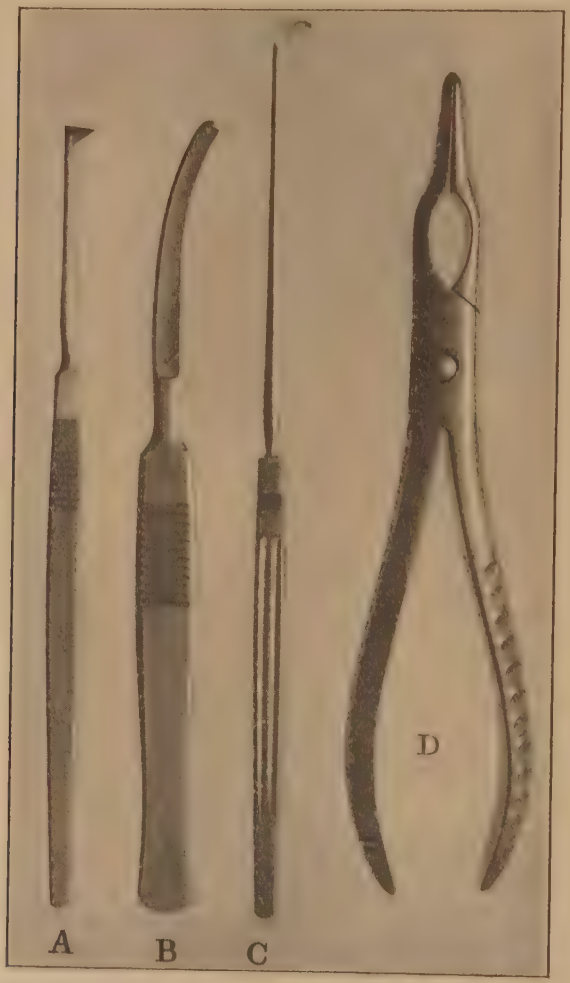


FIG. 27. Instruments for Asch-Douglas septum operation. *A*, Douglas septum knife, spear shape. *B*. Septum knife, blunt point. *C*, Douglas septum knife. *D*, Septum forceps, straight.

Instruments used in the Asch-Douglass operation are shown in Fig. 27.

An operation, at present popular, is the submucous resection of the nasal septum. It may aid the reader to understand this complex procedure, if he will regard the structure as a hard, stiff plate inclosed in a soft, flexible envelope.

FIG. 28.—Instruments for submucous resection of nasal septum. *A*, Allen's nasal speculum, right and left; *B*, scalpel, small; *C*, Ballenger's elevator; *D*, Pott's elevator; *E*, nasal curette; *F*, nasal septum speculum; *G*, Ballenger's swivel septum knife; *H*, Hurd's septum forceps; *I*, Jansen-Middleton's septum forceps; *J*, Asch's septum forceps.

The purpose is to take this plate in whole or in part out of the envelope. A slit is cut near one end of the envelope, through which is passed an instrument which separates the plate from its covering, without penetrating the latter. Then

this instrument is withdrawn to give place to another, which breaks up the plate and is itself withdrawn. A third instrument removes the fragments of the plate piecemeal. The soft, flexible envelope is now empty. The slit cut at the start is closed, the two sides come in contact and ultimately cohere. The result is a structure which upon the outside is unchanged, but which has lost its rigidity and its strong support. It is also rendered thinner by the extraction of the plate. By remembering the above meager outline, the consecutive steps of the operation may be more readily apprehended. The instruments used are shown in Fig. 28.

The first step to be taken is the making of a crescent-shaped incision through the mucosa, submucosa and perichondrium, upon one side of the septum. This incision is about three-quarters of an inch from the tip of the nose with its convexity presenting in that direction. Its length is nearly an inch. Through this slit a small, sharp-edged elevator is introduced and the mucoperichondrium slowly and carefully separated from the underlying cartilage. After a start has been made, a dull-edged elevator is substituted and separation continued along the nasal crest as far as may be necessary, the purpose being to denude the chondroösseous plate over an area somewhat larger than the segment of that plate, which is to be removed. When the limit in this direction has been reached, the divulsion is continued downward by imparting a partially rotary motion to the shank of the instrument which thus detaches the perichondrium, a process called "teasing" (see Fig. 29). Difficulties may be encountered, if there are irregularities upon the surface, but these usually yield to patient and skilful manipulation of the elevator combined with such changes in position as can be effected by traction upon the tip of the nose. If such means fail, one is apt, almost unconsciously, to use greater force, but this is an error. It is much better to withdraw the steel instrument and substitute instead the small, flexible elevator devised by the late Dr. Potts. This instrument is made of copper, nickel-plated,

and has a sharp and also a blunt end. It can be bent to any shape and various curves can be tried until one is found which enables the elevator to insinuate itself around the opposing obstacle. The membranes peel off smoothly before it and it is so flexible as to bend rather than to lacerate the tissues. This instrument minimizes the danger of making such a wound as might result in perforation of the septum, a most regretable accident, whether caused by an operation, or in any other way (see Fig. 28D).

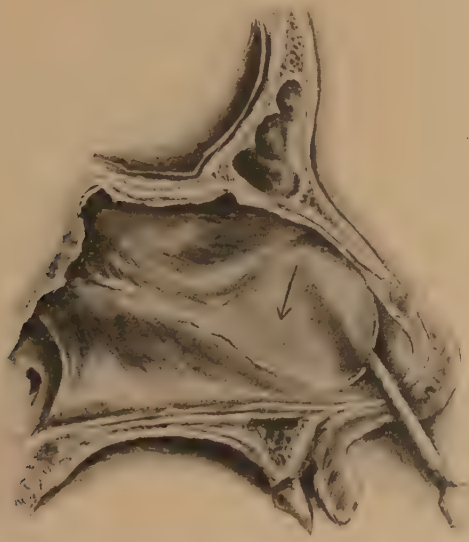


FIG. 29.—Detaching the mucous membrane of the septum by the rotary movement called "teasing." The arrow shows direction of detachment.

When the separation has been continued down to the vomer the tissues will be found much more adherent and, if the bone is to be left *in situ*, the divulsion need not proceed further, but if the vomer is to be taken out, separation of the muco-perichondrium must be completed with a sharp elevator, the membranes being spared injury by making the incision at the expense of the periosteum of the vomer. Some shreds of

this covering, remaining adherent to the soft tissues after the operation, will do no harm.

The separation upon the right aspect of the septum having been completed, the next step is to make a passageway to the other side. For this a spot is chosen near to the primary incision above the vestibule. The surgeon inserts the index-finger of his left hand into the left nostril, opposite the spot

FIG. 30.—The nasal speculum holding back the detached membrane, exposing to view the cartilaginous plate of the septum, in the operation of submucous resection.

chosen, and then cuts through the cartilage slowly and cautiously, so as not to injure the mucoperichondrium upon the other side. A good instrument for the purpose is a curette only moderately sharp. When a hole has been made through the cartilage it is enlarged to serve for the introduction of the elevators with which the mucoperichondrium upon the left side is separated from the central plate by the same process as was used upon the right side. The septum speculum

is now inserted so as to retract the separated membranes, holding them out of the way and giving the operator a good view of the cartilaginous plate and also room to work safely (see Fig. 30). If the progress so far has been free from accident. it has prepared the way for the second stage of the operation—the ablation partial or complete of the internal plate of the septum. This procedure begins with the chondrectomy, that

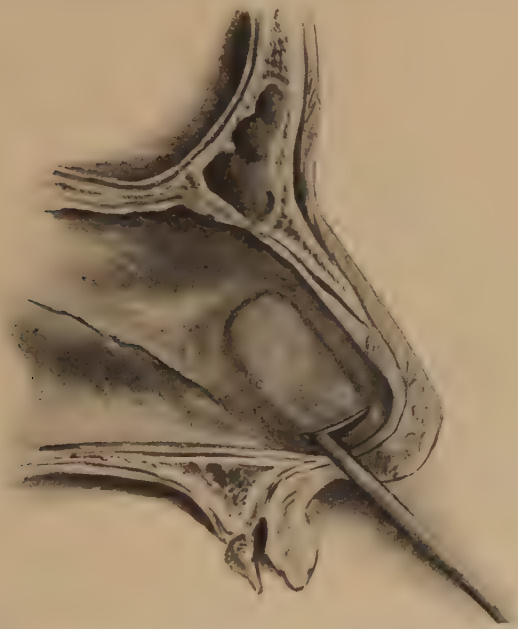


FIG. 31.—The swivel knife is shown returning to the point at which it started, thus completing the separation of a segment of the septum.

may be effected in several ways, among which the preferable one is the use of the swivel knife (see Fig. 28).

It comprises three parts, a handle, a shank of two prongs, and a distinctive contrivance called the swivel. This is a small, rectangular blade with a cutting edge upon one of its longer sides. It swings freely between the ends of the prongs to which its extremities are attached by pivots. On account of this construction it can cut anywhere along a line de-

scribed by the points of the prongs, within a plane at right angles to a straight line joining the two pivots. In preforming the chondrectomy it is first pushed forward, acting in the manner of a gouge and making a section nearly parallel with the nasal crest. The prong points are then depressed and the swivel cuts downward, until the surgeon changes his force to traction, when the swivel acts like a spokeshave and makes a section toward the vestibule, coming back to the

FIG. 32.—The removal of the cartilaginous plate of the septum is here indicated by the rectangle of darker color. In the vacant space are the Hurd forceps blades, engaging the edge of the vomer.

starting point, having traversed the perimeter of the segment to be removed (see Fig. 31). The part cut away is taken out by dressing forceps. It has been found that such cartilage, if immersed in normal salt solution, will retain its vitality for several weeks. It can be used for repair where there has been recent laceration within the nose and even in plastic operations for old perforations.

If any part of the perpendicular plate of the ethmoid requires removal, it can be severed with cutting forceps (Fig. 281). The Hurd bone-cutting forceps is well adapted for removing a part of the vomer by clipping off its upper edge as shown in Fig. 32, but when the entire bone is to be ablated it should be firmly grasped with Asch forceps and dislocated from its

FIG. 33.—The Asch forceps grasping the vomer, in order to remove the bone entirely by disarticulation.

articulations by a lateral rocking motion. The position of the instrument is shown in Fig. 33. Fragments of bone disarticulated, or cut away, are carefully withdrawn from the nostrils with nasal forceps.

After the removal of whatever cartilage and bone were included in the plan for resection, there remains a partly empty,

mucoperichondrial pouch. This should be cleansed of fragments and blood clots and then closed by the coaptation of its two sides which should be retained in position by Simpson-Bernay intranasal tampons. They can be removed in a few days, as the membranes soon unite, fibrous tissue ultimately forming a substitute septum. The original crescentic incision near the vestibule heals in a couple of days without suturing.

Sometimes the only deflection present is that of the columnar cartilage located in the middle of the vestibule (see Fig. 34).

FIG. 34.—Deflection of the columnar cartilage toward the left side.

This condition is readily corrected by making an incision through the mucoperichondrium, parallel with the cartilage, turning the membranes aside and cutting away the deviated cartilage with blunt scissors curved on the flat. Postoperative treatment consists in the application to the wound of a sterile gauze dressing and its inunction with a bland ointment.

Submucous resection is not a suitable operation in childhood and adolescence, when the bone and soft tissues have not

reached full development. As to its value among adult patients, there is the difference of opinion commonly found regarding operations of recent introduction, whose ultimate standing must await the verdict of time. In its favor, the claim is justly made that it gets rid of the obstructive symptoms without impairing the septum's functional value to respiration and to the sense of smell. On the other hand, this operation weakens the support of the walls of the nose, increasing the danger of disfiguring traumatism. It is counterindicated in men particularly exposed to facial accidents, *e.g.*, football players and other athletes. Other questions will be settled when, with the lapse of time, the remote sequels of the procedure come into view, as has been the case with many other operations.

In some cases obstructive symptoms are caused by turgescence of the erectile tissue upon the upper anterior third of the septum. This condition may be corrected, under local anæsthesia, by chemical cauterization, which for the safety of the functionating epithelium of the mucosa, may be effected beneath this membrane. A small incision is made down to the submucous layer. Through this hole is inserted a blunt probe with which the superimposed membrane is loosened and elevated; the probe is withdrawn and its place taken by a canula containing a slender rod bearing upon its extremity a fused bead of chromic acid. After the point of the canula has reached the spot where cauterization is to begin, the rod is pushed forward exposing the acid bead, then by drawing the canula outward, the bead burns a furrow and is again retracted within its sheath. Only a short furrow should be burnt at one sitting. Kidney disease contraindicates the use of chromic acid. If it cannot be employed, the galvanic cautery may be used in its stead, as illustrated in Fig. 35.

Perforation of the septum does not obstruct respiration, but it gives rise to much annoyance and discomfort. Crusts are apt to form around the orifice and patients are prone to pick at them, making the soreness much worse and sometimes inducing epistaxis. Occasionally the orifice is of such a shape

that air passing through it in respiration produces a very audible, whistling sound. Except when due to accident, occurring during an operation, or otherwise, perforations generally begin in the denuding of the cartilage upon one side and gradually break through. Hence there is time for prophylactic treatment and every effort should be made to secure repair of the soft parts, when injured, and to check deep ulceration. These objects may often be attained by cleanliness of

FIG. 35.—Submucous application of the Galvanic cautery to the nasal septum.

the nose and by applying to the diseased spot a mild astringent and alterative. I have found much benefit from an ointment containing four grains of the yellow oxide of mercury in an ounce of petrolatum. I apply this whether the perforation is complete or only threatened and in cases of both specific and nonspecific origin. It has proved valuable in prevention, as well as in palliation.

Aside from traumatism and operative accidents, syphilis is the most frequent cause of perforations. There are generally present, at the same time, other lesions due to the same cause.

In all such cases the patient should be put upon anti-syphilitic, constitutional treatment.

There are two operations for the cure of septal perforations, both of them best adapted to cases where the opening is small. The ribbon operation (Fig. 36) is performed thus: Freshen the edges of the perforation; make a ribbon wide enough to cover the hole, by a curved incision through the soft tissues, on the right aspect of the septum; lift up this ribbon with the elevator, without detaching its ends, then draw it over the hole

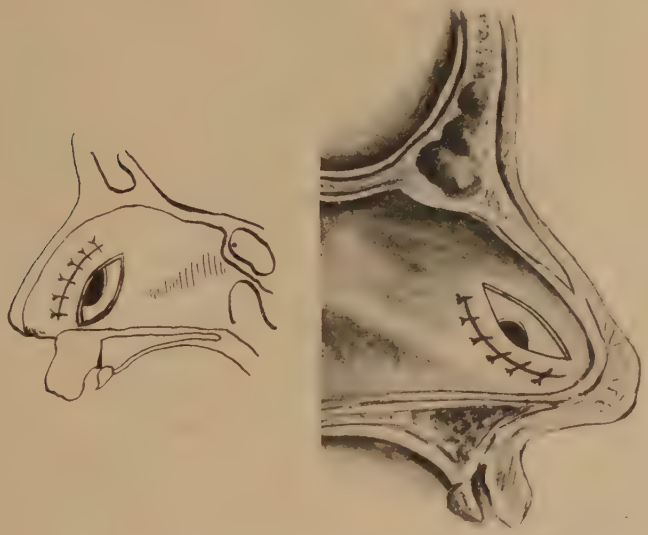


FIG. 36.—Ribbon operation for perforation of septum.

and suture the freshened edge of the ribbon to the edge of the membranes upon the distal side of the perforation. Follow the same procedure in the left nostril, only taking the ribbon from the opposite edge of the perforation. The closure of the opening is then complete, but upon each aspect of the septum the interior plate is exposed through a rift from which the ribbon has been withdrawn. In favorable cases, this rift fills up with granulation tissue and the sutured edges unite, affecting a cure.

The second, or flap, operation (Fig. 37) has the following tech-

nique. Freshen the edges and from either side of the septum select the best membranous flap available. With the trailing swivel knife make an incision down to the interior plate in such a way as to furnish a circular flap, a little larger than the hole, attached to a membranous band which serves as a pedicle. Lift the flap and a part of the pedicle with the elevator and fold them over so that the flap covers the hole; push the flap

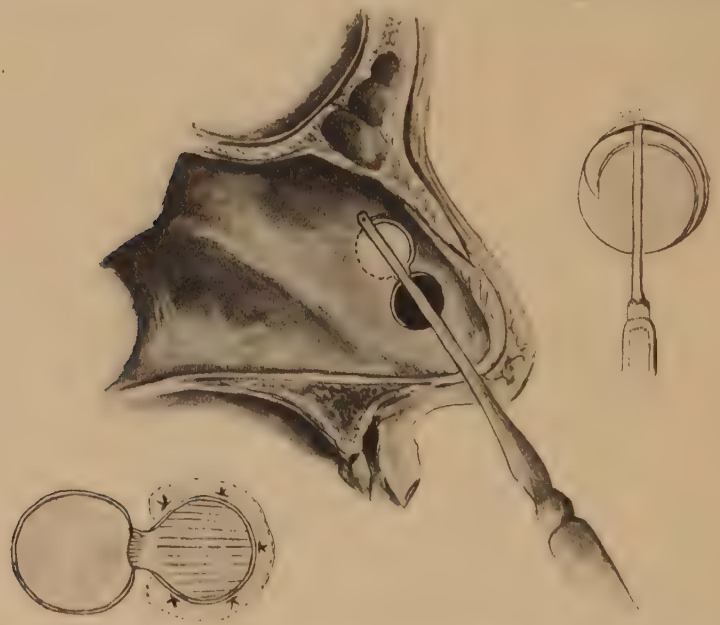


FIG. 37.—Flap operation for perforation of the septum. Observe that the trailing swivel knife, by turning upon its pivot, makes a circular cut.

through the opening far enough to bring its epithelial surface to the level of the epithelial surface upon the opposite aspect of the septum and suture the flap in this position. The result is that upon the side where the suturing is done, there is a continuous epithelial surface of the mucous membrane, while upon the opposite side there are two raw surfaces of circular shape, one produced by the reverse of the flap and the other by the denuded segment of the interior plate from which the flap

was separated. Much granulation is required to cover these areas. If repair is effected and if union takes place along the circular line of the sutures, the operation will have accomplished its purpose, and the perforation will have been closed, but only by a single membranous layer, not, as in the ribbon operation, by two layers.

After either of these operations, the repaired septum requires judicious care, in the way of cleanliness and protection from injury, to avoid a breaking down of the plastic tissue which seldom acquires much power of resistance.

CHAPTER V

NASAL NEOPLASMS

Among organic lesions which obstruct the breath-road, the most frequent, after abnormalities of the nasal septum, are new growths of several kinds, which occur within the nose. Nasal polypi (Fig. 38) are most common and they present a great variety in size, consistency and locality, while nearly always showing some uniformity in their shape which

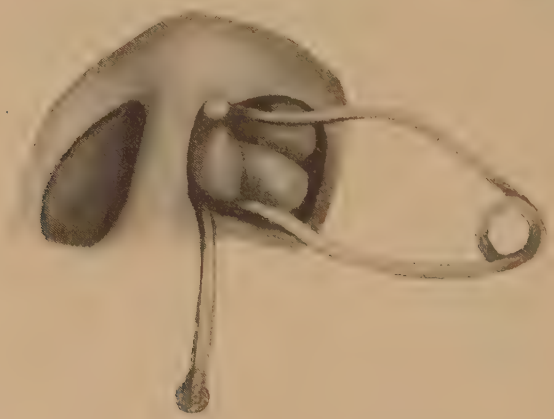


FIG. 38.—Nasal polypi: three in left nostril.

is that of an ovoid body attached by a pedicle to the base, from which it springs. This suspended mass moves freely as far as the surrounding cavity permits. It presents a rather glossy surface of bluish-gray color and, to the sense of touch, is pulpy, so that dents are easily made by the finger or the probe. There is little difficulty in diagnosis. This ovoid body is traversed by fibers of connective tissue and their interspaces are filled with a semisolid substance whose constituents exhibit

much variety in different specimens. Myxomatous material, derived from modified and degenerated elements of the mucous membrane, is a chief component and with it are found mucous and serous glandules, calcareous matter, broken-down blood corpuscles and fragments of dead bone; these things are present in variable proportions and one or more may be absent in particular instances. Small blood vessels ramify through the polyp's epithelial covering and a few traverse the stroma; but the vascularity is usually slight, an important fact in connection with its surgical treatment.

The etiology of the polypus has given rise to many discussions in which every factor in its morbid anatomy and histologic pathology has been considered at length. One group of investigators has held that this neoplasm is a myxoma, or mucoid tumor, and originates in a sacculation of the mucous membrane, gradually enlarging and becoming filled with the diverse elements constituting its contents. The increase at the distal end is faster than at the base, hence the mass assumes a pedunculated shape. The inflammatory conditions near the growth, the involvement of some of the sinuses and the necrosis of bony structures, often observed as coincident phenomena, are regarded as sequels of the obstruction which the polypus causes to respiration, drainage and the circulation of the blood, impeding the nutrition of the tissues and lowering their vitality. Another group has considered the polypus not as the cause, but as the result of the other conditions. According to this view, the bone disease is usually primary and, where this is not present, the etiological responsibility falls upon sinusitis in some form. The polypus is merely a manifestation of an effort to repair the damage already done, but the process of growth is abnormal and, diverted from its proper course, results in a morbid neoplasm which makes matters worse instead of better.

There are three facts, admitted by everyone, which furnish a sufficient basis for treatment, and their bearing and cogency are the same, whether we accept the first theory, prefer the

second, or leave the question open. These three facts are (1) the polypus itself; (2) the concomitant lesions, such as necrosis, sinusitis, etc., and (3) the lesson clearly taught by clinical experience that removal of the growth is very likely to be followed by recurrence, unless the concomitant lesions also have been cured. This is one among many instances where, most fortunately, the adoption of efficient therapeutic measures need not wait upon the adjudication of mooted points in etiology.

The most common site of a polypus is the surface of the middle turbinated body, or the contiguous portion of the fossa, but it may spring from the mucous membrane in any part of the nose. The growth may be single or multiple and sometimes more than a score of polypi exist simultaneously; in such a case, of course, nearly all are quite small. Occasionally a group of diminutive growths, ranged near each other, resembles a group of papillomata, as the pedicles are absent, but the character of the inclosed material classifies these masses as polypoid. The symptoms caused by a single polypus of large size, or by a number of small ones, are those of obstruction and its consequences. One nostril may be almost closed, so that the natural secretions are held back, except when momentarily released by sneezing or violent blowing of the nose. The degeneration of these secretions makes them offensive and they irritate the mucosa, setting up a sub-acute inflammation with a muco-purulent discharge. The patient suffers from itching, burning sensations within the nose, and mouth-breathing brings on dryness of the pharynx and hyperæmia. The resonance of the voice is lessened by encroachment on natural cavities which produce this quality, and the sense of smell is at first affected by cutting off access to its nerves, on one side, and, later, it may be permanently injured by atrophic changes. Vaso-motor rhinitis and asthma sometimes join this train of morbid effects. When the growth continues for a long time without check, it may disfigure the nose externally, making it much broader on one side and

producing the appearance of flattening, although the height of the osseous bridge is not really altered. This deformity is the so-called "frog face," a familiar sight in some countries and at one time quite common here. It is now a rare thing in this country and the change is due to the popularization of rhinology, leading to the removal of the causes producing the disfigurement.

The treatment of polypi by astringents, caustics, or any other half-way measures, is not only futile but injurious. Thorough extirpation is the only rational course, and this will generally effect a cure. When the growth is of some size and has a distinct pedicle, the best instrument for its removal is the cold wire snare. Instrument makers have for sale many forms, but the essential features are a steel loop, which should be made of piano wire, designated as number 5, a biperforate canula through which the ends of the wire pass, a handle, and a screw, by which the wire may be drawn backward toward the handle, slowly diminishing the size of the loop until it disappears entirely, the wire having gradually cut through any body which the loop encircled (see Fig. 39).

Fig. 39.—The cold wire snare, combining the essential features; wire loop, biperforate canula, handle and screw for shortening wire.

When the polypus springs from the middle turbinal, the most common site, it is ablated in this way. Ischæmia and anæsthesia having been produced in both the neoplasm and the adjacent tissues by the application of epinephrin chloride and cocaine (or novocain), the wire snare is introduced through a large nasal speculum, with its loop in the vertical plane, until the tip of the loop passes beyond the growth. The lower side of the loop is then rotated under the bulbous part of the polypus which it now en-

circles. The size of the loop is then slightly lessened by a turn of the screw and it is passed over the pedicle to its base. The loop is then progressively constricted, care being taken that, while one of the surgeon's hands controls the screw, the other hand keeps the loop firmly pressed against the base of the growth, until the wire begins to cut into the pedicle. If this precaution is neglected the incision may be too far out and a part of the pedicle may be left attached to the turbinal.

As the wire bites into the tissue, the rotation of the screw should be very slow so as to get the hæmostatic effect of gradual strangulation. After the pedicle has been divided, the wire snare is withdrawn and the dissevered polypus taken out with dressing forceps. The bleeding which follows this operation is usually slight, both on account of the character of the neoplasm and because the vessels have been occluded by the strangulation. If continued oozing requires a styptic, the most satisfactory is sodium perborate. The moistened cotton tip of an applicator is dipped into the powdered salt and carries it to the bleeding spot. As soon as the perborate comes in contact with the serum of the blood, it generates dioxide of hydrogen. As this is in the nascient state and of full strength, it acts more energetically than the dilute acid solutions of this unstable compound, which are ordinarily dispensed. The hæmic albumen is quickly coagulated and the clot has a firm consistence which may usually be trusted to seal up the capillary orifices. In rare cases packing of the wound for a short time may be required.

The wire snare can be used for polypectomy in other localities, provided its loop can be applied so as to encircle the pedicular part of the growth, but it is not adapted to the ablation of very small polypi, nor those which are sessile and resemble papillomata. These are best removed with biting forceps or with the curette. In all cases of polypectomy the raw surface left by the operation must be carefully examined both visually and with a blunt probe, to ascertain the condition of the underlying structures, osseous or cartilaginous and if any necrosis

be discovered, all sequestra must be removed and the resulting cavities treated aseptically until healing takes place. If this procedure is neglected, a recurrence of the polypi is very probable, a sequel disappointing to the patient and injurious to the reputation of the operator. Moreover, no radical and permanent cure can be expected unless the bones, or the parts of them remaining after the arrest of the disease, are restored to their normal vascularity and are healthy in all other respects.

Fibromata (Fig. 40) are tumors composed of connective tissue and growing very slowly. They are classed with benign neoplasms; but have a tendency, under certain conditions, to undergo a malignant degeneration. On this account, they should be removed as soon as possible after their discovery. Nasal fibromata are rare and most of those reported have been situated near the posterior end of the middle turbinal, on the border of the naso-pharynx. To avoid hæmorrhage they should be extirpated with the cold wire snare, when the tumor can be engaged in its loop. When this is impracticable, cutting forceps and the curette may be employed.

FIG. 40.—Nasal fibroma originating in left fossa. Such a growth is usually removed with the cold wire snare. (*Stout.*)

A hæmatoma (Fig. 41) is a tumor composed of blood and it is sometimes found upon the nasal septum. When a highly vascular tissue is deprived of the support of adjoining structures, the blood vessels become greatly engorged and the pressure against their walls may result in rupture with hæmorrhage, or in a great distension of their coats. This enlargement produces a tumor of dark color, thin, tense wall, and liquid contents, fluctuating to the touch. When, in the submucous resection

of the septum, the removal of the cartilaginous central plate leaves the membranes on each side without their habitual support, a hæmatoma may be formed. This development of a postoperative hæmatoma can nearly always be prevented by giving adequate support to the soft tissues which are subjected to unaccustomed strain. The Simpson-Bernay nasal tampons should be introduced into the nostrils and allowed to remain until the agglutination of the intraseptal surfaces converts the two walls into one, equalizing the pressure of the blood (see Chapter IV, Nasal Septum).

If this precaution has not been taken, or the patient has removed the tampons prematurely, as sometimes happens, and

Fig. 41.—Hæmatoma springing from nasal septum.

the blood tumor has formed, then the sack must be cut open, all its contents thoroughly removed and the cavity washed out with normal salt solution. Afterward the lateral supports can be introduced, so as to bring intraseptal surfaces together and promote their union. Sometimes hæmatomata are due to traumatism. In such cases the accumulated blood must be evacuated, the sack cleansed and its walls brought into apposition by pressure with pads of sterile gauze, cotton, or other suitable substances. The exact technique of applying this pressure depends upon the conditions present in each particular case.

It seems a small matter, but requires knowledge and skill, both surgical and mechanical. To make enough pressure, and not too much; to apply the supporting dressing in such a way that it will not be loosened by respiratory acts, nor by the customary movements of the patient; these and similar things distinguish the competent surgeon from the bungler and they make a very great difference in the result of treatment.

The skin covering the nose may be the seat of furuncles and abscesses, due to infection of the dermal follicles, just as in any other part of the integument. Their symptoms and treatment are nearly the same as when located elsewhere, but on account of the undulating surface and continual movement of the alæ nasi, the outlet of pus in this region, whether spontaneous or by incision, is more apt to leave a scar than at other points; an unfortunate circumstance, as a cicatrix, which would be of no consequence upon some part covered by clothing, may cause much dissatisfaction when in such a conspicuous position. For this reason, it is well to abort furuncles, if possible, and in the papular stage their development may often be arrested by rubbing into the skin a salve made of equal parts of mercurial ointment and the extract of belladonna, and then making pressure with a compress held in place by adhesive strips or by a bandage encircling the head on the plane of the occiput. If this treatment succeeds, resolution will begin in eight or ten hours; so the dressing may be put on at night and removed in the morning.

Intranasal abscesses are nearly always caused by the decomposition of coagulated blood in a hæmatoma. As the clot degenerates, purulent effusion occurs through a fissure in the wall. Treatment consists in evacuating the contents of the sac, cleansing it with an alkaline solution and sustaining the flabby walls by introducing on their exterior tampons or other mechanical supports. If treatment has been neglected, until the formation of a pyogenic membrane, drainage may be required for several days, until the internal surface is covered by granulations.

Malignant disease, in the form of either sarcoma, or carcinoma, is the worst of intranasal neoplasms. It occurs in advanced life and its pathological character, symptomatology and nearly hopeless prognosis, are similar here to what is presented in other regions of the body. If the tumor is thoroughly eradicated, at a very early period of its growth, there is hope that there may be a long interval before its recurrence, and hence an early diagnosis is of paramount importance. Sarcoma usually grows in the anterior part of the nasal cavities and can be seen from the vestibule as a red mass, resembling raw beef, and bleeding upon the slightest pressure with the probe; these characteristics differentiate it from a polypus or a hæmatoma. Carcinoma makes its appearance further back and to the eye resembles a polypus, but it is very dense and hard and, touched by the probe, imparts a sensation wholly different from that given by the pulpy, yielding polypus. Malignant tumors should be operated on, as soon as possible after the diagnosis has been made, and the operation should be thoroughgoing so as to remove every particle of diseased tissue. An external incision is usually required to secure room for the most radical extirpation. Fortunately these growths within the nose are rare. A most thorough search in the surgical literature of all countries was made twelve years ago by some rhinologists in New York and every reported case of either sarcoma or of carcinoma affecting the nose was noted. The total number was less than 200.

CHAPTER VI

NASAL EXTRANEA

Foreign bodies in the nose constitute another class of obstructions to the breath-road. The name is applied only to bodies of some size and does not cover micro-organisms. These are just as extraneous as any others but, in conformity with established usage, they will be classed as nasal infections, which are not primarily obstacles to respiration, but may produce lesions causing obstruction. A unilateral nasal discharge usually indicates the presence of a foreign body, or sinusitis. In children sinusitis is rare; while foreign bodies are found frequently.

The best division of nasal extranea is into (1) the motile and (2) the impacted. The first group includes nearly all whose entrance has been recent; for impaction is generally due to tissue growth, which incarcerates the intruding body, and this requires considerable time. All living insects and parasites visible to the naked eye are obviously motile and of recent introduction. Impacted bodies are sometimes securely hidden and may remain for years quite forgotten, until some accident discloses their presence.

Splinters, metallic fragments, sand and other substances traumatically forced into the nose, either through the vestibule or the ruptured walls, require no consideration here; as their prompt removal is included as part of the treatment of the traumatism. Motile extranea are most frequently introduced at the promptings of an abnormal desire manifested by the insane, the feeble-minded and morbid children, who make the nasal vestibule a receptacle for buttons, coins, beans, peas, lead shot, balls of masticated paper, fragments of chewing gum and other articles. Sometimes children, who do this, are

bright enough mentally; but are obsessed with a pernicious curiosity, which leads them to use all parts of their bodies for experimental research. With such children an efficient prophylactic is the punitive discipline, far too much neglected in our time. Most of the articles put into the vestibule drop out again; but occasionally one slips backward into the fossa and moves from place to place until it either reaches the nasopharynx and falls into the throat, or is arrested by some constriction and remains fixed. It is then likely to obstruct respiration and to excite inflammation at the point where it lodges, bringing on pain, a muco-purulent discharge and sometimes swelling of one side of the nose. The symptoms attract parental attention and at last the child makes a reluctant confession. It must be said that, if the handiwork of the youthful experimenter were brought to the rhinologist directly, it would be easy to dislodge the extraneum; for at this time, it is usually quite accessible; but there is an intervening stage, when maternal solicitude and ignorance have free course; snuff is given to excite sneezing, there is violent blowing of the nose, the toothpick, hairpin and glove-buttoner are plied industriously, often starting a profuse epistaxis. The doctor is not sought until blood has been shed and, by that time, the case has become one of real difficulty, with the foreign body harder to reach and more firmly held.

The surgeon's first effort is to secure from the patient as good a description of the object as possible. Often the task is easy and the doctor gets a truthful, accurate story from the child who told his mother nothing but garbled falsehoods. Of course, no such diagnostic help can be expected from the insane or feeble-minded. Having gained an idea of the intruding body, one can judge of the number of situations it may occupy, *e.g.*, a cherry stone will not be found in the antrum of Highmore because the ostium maxillare is not nearly large enough to admit it. The examination should be deliberately made with the nasal speculum and blunt-pointed probe and, when there is much soreness and swelling, as there usually

is, in consequence of the injudicious measures already taken, cocaine and epinephrin chloride should be applied to obtund sensation, to secure ischæmia and to get more room for inspection. As this is a case where these drugs are used once for all, there is surely no need for timidity in employing them. Many a surgeon is depreciated as less intelligent and less skillful than another, simply because that other made a roomy and anæsthetic field for his operation. If other means fail to discover the foreign body, the *x*-ray must be employed. It is most helpful in case of metals or other substances of great density and these constitute the majority. Removal should be in accord with a principle of some importance, viz: that, whenever possible, the extraneum should be withdrawn through the same passage by which it entered. This withdrawal may be effected with a probe bent at right angles near the point, by a loop of copper wire, or by forceps with dentated, corrugated, or cup-shaped terminals. Neat work depends upon anatomical knowledge and mechanical ingenuity and deftness. In rare instances, pushing into the naso-pharynx may be the most practicable course of removal. This involves danger of dropping into the larynx; which is much lessened by placing the patient upon the back with the head slightly lower than the shoulders. Sometimes a foreign body goes into a crevice easily enough, but refuses to come out, though it is hard to tell what holds it. A slight incision, a mere nick, may release it, and it is better to make such a cut than to procrastinate with continued traction and other manipulations. When the offending body is out of the way, all the symptoms rapidly disappear and no treatment is commonly required, except one or two irrigations with an alkaline wash and a few sprayings with camphorated liquid petrolatum, five grains to the ounce.

Insects, either in the winged or larval form, sometimes enter the nose and there are reports of the deposit and development of their ova in the sinuses. Such accidents really belong to tropical medicine. All such intruders are certainly destroyed by chloroform, and this, mixed with liquid petrolatum (1:8)

can be used as a spray, care being taken to prevent injurious inhalation, by injecting only a little at a time.

After the parasites are killed, the nose should be thoroughly cleansed by irrigation.

When the presence of an impacted body is suspected, search for it should be made in the same manner as for one of recent introduction and in this case the *x*-rays prove of especial value; for the long-hidden object is nearly always of a dense character and has also been covered by calcareous matter, gradually deposited upon its surface. These encysted bodies look somewhat like vesical calculi and have been called rhinoliths. The extraction of such an object may require some time and a general anæsthetic may be needed. The route by which removal is accomplished depends on the conditions of each case. Preference is given to the natural nasal passages, so as to avoid the danger of external scars; but if the mass cannot be taken out in this way, then an incision must be made from outside; for we dare not leave the foreign body, after it has begun to give trouble. However long it may have been harmless, it will not resume a quiescent state, after morbid activity is manifested. Often the cicatrix following removal through the nasal walls is so small, as to attract little notice. Whatever the operation, hæmorrhage is usually slight, as the encysted body has been walled off by fibrous tissue. The emptied cavity should be treated antiseptically and continuously drained, until it is obliterated by granulation.

CHAPTER VII

RHINITIS

Rhinitis is the general term signifying inflammation of the intranasal mucous membrane and includes the different forms, such as acute, chronic, suppurative, vaso-motor, and the types manifested in the different localities, the passageways and the contiguous cavities, or sinuses (sinusitis). In all places the phenomena are similar with modifications caused by different conditions of accessibility, of ventilation and of drainage, between a canal open at both ends and a chamber with only one outlet. The obstructions, considered in former chapters, are connected with inflammation by a causal relationship which is reciprocal. They are often an important factor in bringing on attacks of inflammation and, conversely, such attacks, if of long continuance, or frequent recurrence, may produce structural changes of an obstructive character.

A large proportion of the diseases affecting not only the nose, but all other regions of the body, are of an inflammatory type and suggest a fundamental question: What is inflammation? Elaborate consideration of the answers to this question belongs to those studies, which the reader has pursued before taking up a speciality; but there are a few principles so essential to clear thinking upon our present subject that they must be briefly reviewed. The answer to the basic question may be given from either one of two standpoints. (1) We may endeavor to explain the etiology and pathology of the process; (2) we may describe the symptoms and physical signs. This second answer is important diagnostically and clinically. It is by rational symptoms and by physical manifestations that morbid processes are identified, nine times in ten; the tenth case being the exception, when diagnostic

certainty requires further investigation. The symptoms and signs are valuable clinically because they indicate the treatment advised by a long succession of therapeutists, who have expressed their opinions in the terms of symptomatology. This answer is also easy to give. The ancient physicians, who were most accurate observers, drew word-pictures of the inflammatory process of almost photographic fidelity. Their hypothetical etiology, sometimes interesting, sometimes almost grotesque, has long been obsolete; but their symptomatology has stood the test of the centuries. They gave us that classic aphorism intended to fix in the memory four leading characteristics of the process; *calor*, *rubor*, *tumor*, *dolor*, and daily experience attests the truth that heat, redness, swelling and pain, are the most constant signs of inflammation.

The other answer, which logically has precedence, views the question from the standpoints of etiology and pathology. It is far more uncertain. Many theories have been accepted upon the authority, or arguments, of distinguished men; only to be discarded on the advice of others equally eminent. The actual phenomena look to us just as they looked to Hippocrates, but their interpretation seems to be as varied as the meanings of a Delphic oracle. The theory most widely accepted, at present, regards inflammation as a defensive warfare against invading microbes. The leukocytes destroy the pathogenic germs and are stimulated to this action by the opsonins. Overaction may do harm; but the process is usually conservative and should be encouraged up to the point of destroying all the invaders and removing the cell detritus resulting from the conflict. This theory directly contradicts the former doctrine that inflammation, where mild or severe, was a harmful process, which it was our duty to antagonize.

It might be thought that such a revolutionary change would have brought about a reversal of all the therapeutic measures previously used. Fortunately nothing of the kind occurred. The profession had too much common sense to discard remedies of well-proved value because of changed

opinions in pathology. The clinicians and laboratorians have come to an agreement by the simple expedient of attributing to the remedies a new *modus operandi*. Then therapeutic measures remain the same, but it is now said that, instead of antagonizing inflammation, they really augment it. This method of accommodating both fact and theory is well illustrated by the present view of counter-irritation. From days of old, it was common to apply a mustard plaster over the site of a deep-seated inflammation. Rubefaction, perhaps vesication, took place. The patient was greatly benefited. That was the *fact*. Our predecessors explained the improvement by saying that the inflammation, which had been working serious mischief inside the body, had been drawn to the surface, where it was comparatively harmless. The rubefaction, etc., were taken as proofs of this metastasis. We also apply the sinapism and observe good results, but we say that it acts by increasing the beneficent inflammatory process; it attracts more blood, bearing more leukocytes to the contest, and also transporting their auxiliary opsonins. We regard the rubefaction, etc., as evidences of hyperæmia on the surface and also beneath it. It is worth remarking that either of these explanations, or any other, is quite satisfactory to the patient, so long as he recovers. The rational course of the physician is plain. If he has a remedy, of whose value he is sure, he should learn its method of action, if he can; but even without such knowledge both reason and conscience require him to employ it, until he discovers something better. New remedies suggested by theoretical considerations are subjects for experiment; but they have no place in therapeutics till approved by clinical experience.

These matters have been considered in this chapter, because it deals with the first of the inflammatory diseases to be considered. The observations apply to inflammations within the nose; but are equally pertinent to those of other regions; for diversities in structure, position and function, do not alter the validity of the principles laid down.

Acute rhinitis is in our climate a very common, perhaps the most common disease. Its synonyms are coryza, catarrh of the nose, cold in the head, and they indicate the popular belief that it is due to the action of cold, an opinion that has given origin to the very common phrase, "taking cold," which, though sometimes used in other senses, generally means contracting coryza. This idea of causation voiced in colloquial speech was formerly shared by the profession, but modern bacteriology includes this disease in the category of those produced by germs. It is certain that in the nasal discharges microbes of many species are often found, but which particular one is responsible for rhinitis has not been determined. Indeed, any bacteria floating in the air may enter the nostrils and, becoming entangled in the vicid secretions, be apprehended on the spot, although guiltless of any part in producing the inflammation. There can be no question that acute rhinitis is more prevalent in the winter than in the summer, nor that it is especially frequent in our country, where marked changes in temperature occur so suddenly. Cold, particularly when associated with humidity and when quickly succeeding warm weather, is in some way connected with its production. Both ideas of its etiology are recognized in the view which regards micro-organisms as the cause and cold with dampness as a condition most favorable to the operation of that cause.

Rhinitis both in its acute and chronic forms is to some degree an occupational disease. Ballet girls who, while scantily clad and freely perspiring from muscular exertion, are exposed to chilling drafts from the rear of the stage are frequent sufferers. Those using the sand blast are often attacked, although they seek protection by covering their faces with screens. Smoke, dust and other mechanical irritants may act as exciting causes and the same is true of corrosive chemicals, such as the fumes of many acids. Among predisposing causes are classed the gouty diathesis and various dyscrasias, which lower vitality and diminish the organism's power of resistance; but the most

important predisposing factors are adenoids and abnormalities of the nasal septum, which cause such encroachment upon the breath-road and such hindrance to proper drainage that the various functions are performed only while there exist favorable conditions—there is no lee-way to neutralize unfavorable influences. Therefore, when the environment becomes injurious there is congestion, atresia and a train of morbid phenomena. The man with an obstructing septum contracts severe rhinitis from hostile conditions which do no apparent harm to the man whose septum is normal.

FIG. 42.—Interior view of the right wall of the nose, in a normal condition, showing the turbinals, whose structure renders them liable to a high degree of congestion.

The symptoms of acute rhinitis range themselves in three stages. In the first, the mucosa is dry and tense, its color assumes a deeper shade and there is marked congestion, which particularly affects the turbinals on account of their spongy structure (Fig. 42). This congestion hinders or entirely stops nasal respiration and the patient is forced to breathe through the mouth. There is much discomfort, frequent sneezing and

sometimes frontal headache. A common symptom is general chilliness and the patient says, "I feel I am catching cold," while the clinical thermometer may show no change in temperature, or even indicate a slight elevation. After a few hours there appears a watery discharge, "running at the nose," which consists of serum, leaking from the capillaries, mixed with much mucin from the glandules. The turgid condition of the mucosa is relieved by this outflow and the patient is more comfortable, except for the disagreeable dripping of the viscid liquid. After a variable time, often two or three days, the discharge becomes much thicker and its color changes to straw yellow. This is the third stage, characterized by the outflow of pus, due to the peripedesis of the leukocytes. This purulent discharge continues freely for a day or two and then diminishes. As its quantity grows less, it produces peculiar sensations, which lead the patient to expel it by blowing the nose; there is some evaporation and the residuum becomes semi-solid in consistence. At this point the attack may terminate, or it may last longer and the drying muco-pus form thin crusts. The disease usually passes through these stages, "runs its course," in a week's time, but the duration may be less if the patient is removed from the influence of the exciting cause. The disease may be aborted during the first stage, the inflammation ending by resolution; or it may stop while the discharge is mucoserous, before any pus appears. These cures are sometimes spontaneous and sometimes the result of treatment.

Acute rhinitis, if it is confined to the nasal passages and is not greatly prolonged, commonly ends in complete recovery and does no permanent harm. If, however, there be extensive involvement of the sinuses, or if the middle ear be affected, its sequels may be much more serious. A prolongation of the attack generally signifies some underlying organic trouble. Tedious attacks, indeed, are often found to be exacerbations of a chronic affection rather than truly acute seizures.

In treating this disease, the physician is forcibly reminded of the paradoxical saying that "the best patients get the worst

treatment." In many acute inflammations remarkable good is done by detergent and sedative measures. A warm bath followed by moderate purgation and a mild diuretic, a milk and water diet, with rest in bed and entire physical and mental inaction—these things both mitigate and shorten the attack in a surprising way. Such treatment is readily accepted by the idle novel reader, the lounger in bar-rooms and the hospital sponger—useless individuals well content to take things easy and let others provide for them. They make admirable recoveries; but the forceful people, whose lives and health are most valuable to the community, are often antagonistic to this method. Unless their diseases are absolutely disabling, they try to keep on their feet and will not interrupt their work. In consequence, they frequently suffer permanent injury from an illness which should have caused no lasting damage. Men of this sort are greatly benefited by sojourn at foreign spas, or sanatoria, where they rapidly improve, because they are cut off from mental and physical strain and make a business of getting well by assiduously following their physicians' directions. At home, they get only that part of the treatment which can be given to one still actively occupied, and the doctor must bear that fact in mind and adapt his measures, as far as possible, to ambulatory conditions. It may not be practicable to enforce a milk diet, but stimulating foods can be excluded and alcohol and tobacco forbidden. The sexual functions have a marked influence upon the nasal mucosa and, while it is inflamed, should be as far as possible in abeyance. Tea and coffee are usually objectionable. One or more free movements of the bowels should be secured, at the start, by administering at half-hour intervals, until they operate, tablets each of which contains a fourth of a grain of calomel and one grain of sodium bicarbonate. This is advantageously followed every two hours by a capsule containing hexamethylenamin (urotropin), gr. jss and acetyl-salicylic acid (aspirin), gr. v.

Sedative and ischæmic effects should be produced by spray from an atomizer. The best vehicle is the normal salt solution,

sodii chloridi ℥j ad aquæ destillatæ Oj, which should be quite warm when used. The addition of ten grains of cocaine hydrochlorate to an ounce of this excipient makes a two per cent. solution, which is the proper strength for spraying. Epinephrin chloride should have the proportion of 1 to 10,000. A solution of nearly this composition is made by adding a fluidram of the usual preparation of epinephrin chloride (1 : 1000) to a fluidounce of the salt solution. Menthol and camphor prove valuable for topical application. Five grains of each should be dissolved in an ounce of liquid petrolatum and the compound painted upon the mucous membrane with a cotton-tipped applicator.

These measures serve to modify the course of the disease, rendering it milder and shorter and less liable to produce injurious sequels. The accumulation of discharges impels the patient to blow his nose very often and he should be cautioned to do this gently, for violence may drive muco-purulent fluid, which has trickled back into the naso-pharynx, through the lower orifice of the Eustachian tube and induce inflammation of the middle ear, a complication much worse than the primary disease.

When acute rhinitis merges into the chronic form, there are usually organic changes and the disease assumes either the hypertrophic or atrophic type; but aside from these, there is a peculiar chronic variety which is very prevalent among children in our climate. Its special characteristic is a profuse and persistent muco-purulent discharge, which excoriates the vestibule, the alæ nasi and upper lip, and they become covered with crusts of repulsive appearance interspersed with raw, granulating fissures, from which the scabs have been picked. This is so marked a feature and is so common among lads of from four to ten years that it has given rise to a vulgar, but expressive, nick-name for a small boy who is untidy and ill-kept. The superabundant pyorrhœa appears to arise from the great vascularity and mutability of the tissues still in the stage of active growth and in which the proliferation and metabolism

of cells are very rapid. These conditions accentuate the inflammatory processes.

This disease is much more common among boys than among girls, perhaps on account of their rougher life and their neglect to keep the nose clean. Among exciting causes are ill-ventilated and overheated rooms, from which the boy emerges to freezing temperature and the handling of snow; wet feet due to broken shoes; unsuitable clothing, often too thick; indigestible food hastily swallowed and, among the poor, deficient in nutritive value.

The treatment comprises correction of the bad hygienic conditions, regulation of the bowels and cleanliness of the nose. The turgescence of the turbinals, which is a marked feature in most cases (see Fig. 42), is well reduced by anointing their mucous membrane with the glycerite of tannin on a cotton-tipped applicator. The granulating surface left by the removal of crusts, scabs and dirt from the vestibule should be treated with the ointment of the yellow oxide of mercury. A safe and efficient lotion for use at home, three or four times daily, is made by adding to four fluidounces of the normal salt solution eight drops of the tincture of iodine. This must be prepared each day, as it deteriorates if kept. It is to be slowly and carefully injected with a soft, all-rubber, ear syringe, the head being inclined forward so that the liquid may not run back into the naso-pharynx. A great deal of good can be accomplished by this treatment perseveringly followed, and it is a serious mistake to neglect this rhinitis of childhood, as is so often done; for, when long continued, it not only injures the nasal tissues, but does harm to the surrounding organs, rendering them more susceptible to infections in later life.

Hypertrophic rhinitis, also called hyperplastic, is characterized by thickening of the soft tissues, especially those covering the lower turbinate bone. It is generally the sequence of many recurrent acute attacks, particularly when these have been "left to nature" or improperly treated. The hypertrophy to some extent interferes with respiration and, when a

temporary congestion makes it worse, there may be closure of the breath-road on one or both sides. The symptoms are those of obstruction, more or less complete, with mouth breathing and the laryngeal, bronchial and even pulmonary irritations which follow it. There is also nasal discomfort and frequently some change in the vocal intonation, which loses the resonance produced in the naso-pharyngeal vault. Left to itself, the disease usually pursues a course of gradual extension, with intervals when it is stationary. Spontaneous cure is not to be expected. The first step in treatment is to thoroughly cleanse the nose by gentle irrigation with the normal salt solution; the next is to remedy as completely as possible any catarrhal conditions which may be present, by employing the measures recommended in acute rhinitis and given in detail in its consideration. In fact, catarrhal conditions are often presented, for the patient is very apt to apply to the specialist at a time when he feels worse than usual, because his chronic affection is aggravated by coryza.

Having gone this far, we reach a dividing of the ways and must decide whether the hypertrophied tissues shall be partially removed or an effort made to secure their absorption by means of the lymphatics. Some years ago, the galvanocautery was widely used, under the belief that the resulting eschar destroyed part of the superfluous tissue and that the cicatrix, having been produced by a burn, would progressively contract, making pressure upon the underlying blood vessels and permanently inhibiting the recurrence of congestion and turgescence. This procedure was adopted by many surgeons, because it appeared to be a rational and ingenious application of existing knowledge regarding the cicatrices following burns; but experience soon showed that it was liable to a very serious objection, not foreseen by those who introduced it. When the cautery was used upon the middle turbinal, the marked inflammatory reaction not infrequently extended to the membranes of the brain and produced meningitis. As there is no method for warding off this danger, it has now become a maxim of rhinology that the

galvanocautery is prohibited in operations upon the middle turbinal. No blame attaches to those who devised the operation, for the risk of meningitis could not have been predicted: it is altogether a matter of *post factum* knowledge. The introduction, acceptance and disuse of the cautery illustrate a truth which must always be remembered: that no operation, however promising it seems, however logically its principle is

FIG. 43.—Removal of anterior part of middle turbinal. The incision across the front end is made with scissors. Through this is introduced the wire loop to encircle the part to be removed. The dotted line indicates the segment of the loop concealed from view behind the hypertrophied mass.

deduced from former knowledge, can gain full approval and confidence, until both its value and its safety have been proved by long and wide experience.

When hypertrophies upon the middle turbinal are of such shape that they may be encircled by a loop, they may be removed with the cold wire snare as depicted in Fig. 43, or by cutting forceps. Ridges and rugosities can be reduced with the curette. These instruments can be used also upon the inferior turbinal, and in its treatment the galvanocautery appears to

be safe and hence may be employed when cicatricial contraction is desired.

Cauterization with chemicals produces a milder reaction than the galvanocautery and is not apt to set up meningitis, hence it is suitable for use upon the middle turbinal and elsewhere. Chromic acid is often employed, either by lightly drawing a fused bead across the surface, or by the submucous method with probe and canula. The trichloracetic acid also may be used for cauterization and its chemical action upon the tissues is similar to that of chromic acid. As compared with incisions by sharp instruments, these caustics produce more inflammation, requiring longer time for healing. On the other hand, as they act by desiccating the tissues, they do not cause hæmorrhage. The surgeon must choose the plan of treatment best suited to the patient, taking into account the local lesions and also the constitutional conditions of the individual. In all cases he should, as a preliminary, secure local anæsthesia and make the nasal fossa as roomy and as clean as possible by contracting the turbinal tissues (cocaine or epinephrin chloride, or both) and washing away all secretions and discharges with the normal salt solution, that of Dobell, or some other lotion of alkaline character. All these washes act better when warm.

The nonoperative treatment has for its object the depletion of the hypertrophied tissues by absorption of part of their substance through the lymphatics. This is a strictly physiological process, capable of stimulation by certain chemicals, which act either topically or through deep-seated glands, perhaps by modifying the control of histogenetic processes by the adrenal chain of the so-called ductless glands. This process of absorption is necessarily slow, and does not satisfy those who demand an immediate cure; but there are patients who prefer prolonged medicinal treatment to any shorter method which involves cutting or burning. After looking at the matter from all sides, the surgeon may decide upon the plan for slow reduction: its results may prove highly gratifying; if it fails, the operative measures are in reserve.

The remedies used are those which have astringent and eliminative qualities. Boulton's solution, which was introduced more than twenty-five years ago, has the following formula:

℞. Tinct. iodini comp..... ℳxx
Acidi carbol. (pure)..... ℳvj
Glycerini..... fl.℥vij
Aquæ dest..... fl.℥v. M.

This is sprayed by an atomizer three or four times a week, but is not entrusted to the patient for use at home. Distilled extract of witch-hazel, diluted with an equal quantity of water, is employed with similar frequency and under similar restrictions. Camphor and menthol, which are most efficient when conjoined, should be applied to the hypertrophied tissues and to the mucosa of contiguous parts. From five to ten grains of each remedy are added to a fluidounce of the officinal petrolatum liquidum and the unctuous liquid used with a cotton-tipped applicator.

Chronic rhinitis not unfrequently causes an inflammation of the lachrymo-nasal duct, which when long continued produces stenosis, preventing the drainage of the tears from the lachrymal sac into the lower meatus of the nose. This is a very unfortunate sequel of the disease, inflicting, in addition to habitual discomfort, a great deal of annoyance and vexation. Deprived of their normal outlet, the tears overflow the orbital margin at the inner canthus, simulating continued weeping upon the affected side, and running down over the cheek irritate the skin, even macerating it in persons whose integument is specially tender. Often to this overflow, termed epiphora, there supervenes suppuration of the lachrymal sac with exudation of pus, habitually appearing as a dirty yellow globule at the canthus, replaced almost as soon as wiped away.

Patients are so much distressed by this morbid condition that they will endure and even solicit radical orbital operations, in hope of relief. In many instances, ophthalmologists

to get a "dry eye" have enucleated both the lachrymal sac and lachrymal gland, thus destroying a healthy organ, for the gland is rarely diseased, and abolishing a normal function on account of a morbid condition outside the orbit. Such operations are now rarely performed. It is recognized that nine-tenths of the cases of epiphora originate in the nose and it is here, not in the orbit, that remedial work should be done. The procedure which came into vogue, under the influence of this idea, was the restoration of patulency to the closed lachrymo-nasal duct. Its orbital aperture was enlarged and efforts made to restore its lumen to an adequate size, by the successive passage of a graduated series of distending probes. Some success attended this treatment, especially where the duct was obstructed but not occluded. It proved inefficient where there were inflammatory adhesions of long standing and, in all cases, it was painful, tedious and uncertain in its results.

Impressed by these objections to the method of dilation, several operators determined to abandon the effort to enter the duct from the orbit and to start at the other end, where it and its inclosing bony canal terminate in the inferior nasal meatus. This method speedily won favor with surgeons on the European continent and, while all had a common purpose, there was much diversity in the technique adopted by different rhinologists. The various plans which had proved reasonably successful were finally epitomized and analyzed by Onodi in an elaborate thesis, which has proved the groundwork for most subsequent studies of the subject.

Sidney Yankauer worked for three years as a follower of the method advocated by Onodi, which may be regarded as a composite, embracing those features of various operations which have best stood the test of time. With this experience as a guide, he devised the operation which bears his name and which, during the two years it has been before the profession, has won the approval of many American rhinologists. A descriptive outline follows:

The patient receives a hypodermic injection of morphia or of morphia-scopolamin, the object being to make sure that general sensation is somewhat obtunded independent of the effect of cocaine, because there is sometimes difficulty in administering the local anæsthetic at the stage of the procedure when it is most needed. He is placed on the operating table in the semi-recumbent position, the operator standing beside him and face to face: a solution of cocaine (10 per cent.) and epinephrin ($\frac{1}{2000}$) is applied if the canal is occluded; if it is pervious, the anæsthetic liquid may be introduced to its interior through the lower orifice. When much time is consumed, additional anæsthetic applications may be required. To get as much room as possible in the nostril of the affected side, the septum is drawn away and held by a retractor, during the operation. The mucous membrane of the outer nasal wall in the area including the lachrymo-nasal canal is divided by a vertical incision on the border of this area, which is nearest the nasal crest, and by two horizontal incisions extending backward from the upper and lower ends of the vertical incision; it is then separated from the subjacent structures by an elevator and forms a rectangular flap which is turned backward and carefully guarded from injury. The next step is to open up the osseous canal through its entire length. This is done with bone-cutting forceps or a guarded chisel, care being taken not to break into the maxillary sinus. By clearing away the osseous fragments the membranous duct is exposed to view. With suitable scissors or knife this duct is slit open from below upward, all the way from its lower orifice up to and including the lachrymal sac. All strictures are divided; the venous plexus surrounding the canal is destroyed; any accumulated pus cleaned away and the entire passageway, converted into an open sulcus, thoroughly cleansed. Finally the flap of mucous membrane is restored to its place and its union with the subjacent surface promoted by careful packing of the nostril with sterile gauze. When satisfactory union takes place and there is no excessive

inflammatory reaction, the end result of the procedure is a tube with an osseous wall on its outer side and a wall of mucous membrane toward the septum. This tube has a lumen somewhat larger than the original duct and furnishes ample lachrymal drainage.

Yankauer's operation was brought before the profession only two years ago and, of course, a longer period is necessary for such experience as will accurately determine its place in orbito-nasal therapeutics; but there is hope that it may prove a curative procedure in a morbid condition, whose treatment by other methods has been very disappointing.

Hypertrophies of the posterior part of the lower turbinal have peculiar features due to their position on the margin of the postnasal cavity. They can extend backward without meeting any resistance and hence often attain great size, causing obstruction to respiration and interfering with the functions of the Eustachian tubes. As they rest upon the upper surface of the velum palati, they frequently embarrass its movements. By anterior rhinoscopy, through dilated nasal fossæ, such an hypertrophy appears as a tumor rising and falling with the motions of the velum. Posterior rhinoscopy shows a granulated or lobular mass attached to the end of the lower turbinal and perhaps large enough to hide the nasal septum. Such a growth gives rise to a muco-purulent discharge like that observed in chronic rhinitis. Two hypertrophies of this kind are shown in Fig. 44, a reproduction of the image appearing in the postnasal mirror held in the naso-pharynx. The growth should be extirpated, under cocaine anæsthesia, by introducing the cold wire snare through the anterior nares and encircling the tumor in its loop. Twenty or thirty minutes should be allowed for gradual strangulation, as a precaution against hæmorrhage. The postnasal mirror or a finger in the naso-pharynx will aid in adjusting the snare. This operation is illustrated in Fig. 45.

The reduction of hypertrophies necessitates the separation and removal of redundant cells from the tissues and the

remedy which renders this service better than any other, is iodine. Just how it acts is still a mooted question; but there

FIG. 44.—Two hypertrophic tumors upon the posterior ends of the lower turbinals, as shown by the image in the posterior rhinoscopic mirror.

FIG. 45.—Removal of a hypertrophic tumor from the posterior end of the lower turbinal, with the cold wire snare.

has long been abundant proof of its power to cause catabasis of the cells in tumefactions, without such degeneration as

would render them toxic. It appears simply to dislodge them and to start their emigration through the lymphatic vessels.

A solution of iodine adapted to the skin requires much dilution for use upon the mucous membrane. If too strong, it devitalizes the epithelum and the dead cells prove a barrier to absorption. Some irritation is to be expected; it simply shows that the drug is taking effect, but this reaction must not be severe, or the purpose in view will be defeated, and this is a mistake very often made. The physician's skill is manifested in so regulating the strength of his solution, that the iodine molecules will penetrate through the soft tissues and start the cellular migration. The three formulæ following have been accredited by long experience; the weakest solution should always be used at the start; then, if the membrane seems insensitive, the second should be employed. It is a very efficient remedy and as strong as is ever indicated in the hypertrophic form of the disease. The third solution may be needed in some intractable cases of atrophic rhinitis which have resisted other treatment.

No. 1. ℞. Iodini..... gr. viij
, Potass. iodidi..... gr. xxiv
Glycerini..... fl. ℥viss. M.

No. 2. ℞. Iodini..... gr. xij
Potass iodidi..... gr. xxxvj
Glycerini..... fl. ℥viss. M.

No. 3. ℞. Iodini..... gr. xvj
Potass iodidi..... gr. xlviij
Glycerini..... fl. ℥viss. M.

It will be observed that in all these prescriptions the amount of the vehicle, glycerine, is the same, viz: six and one-half fluidrams, also that the potassium iodide, added chiefly to promote solubility, is thrice the amount of the iodine. This, the essential thing, varies from eight grains to twelve and sixteen, making the preparations respectively nearly two per cent., three per cent. and four per cent. solutions of iodine in glycerine. The technique is the same in each case. Sensa-

tion is rendered dull by applying a two per cent. solution of cocaine hydrochlorate to the hypertrophied tissues, which are then lightly coated with the iodinized glycerine. The cotton pledget upon the applicator must not be wet enough to drip and must not cause undue pressure.

As the elimination of the superfluous cells depends upon their absorption by the lymphatics, sufficient time must be allowed for such action. The patient should be seen three times a week, so that the application may be repeated upon alternate days. When this treatment is followed patiently and persistently, a large proportion of the cases are cured.

Atrophic rhinitis, also called dry rhinitis and ozæna, has two well-marked characteristics, by which it is easily recognized; the formation of large crusts composed of cellular débris of various kinds undergoing putrefactive changes and a repulsive odor disseminated at every expiratory act. This evil smell has a peculiarly nauseating effect upon some healthy people, so that if they come into contact with a patient, emesis is unavoidable. The patient is often unconscious of the odor, because the disease is apt to destroy the terminals of the olfactory nerves and thus abolish the sense of smell. Although the repulsive character of ozæna undoubtedly depends upon the decay of animal matter, it has some peculiar qualities which are *sui generis* and this has led many to think that a microbe adds to the putrefactive gases an additional substance not yet isolated. The patient's knowledge that he is repulsive to others often causes him keen mental distress and *a priori* it would seem that the inhalation of tainted air would soon produce most serious autointoxication. It is one of the enigmas of pathology that many persons are for years rendered repulsive by this symptom and yet maintain a state of comparatively good constitutional health.

While the sclerotic variety of rhinitis, which causes little odor, is a sequel of the hypertrophic form, the atrophic variety very often follows the purulent rhinitis of childhood. The etiological factors in the atrophic type of the disease are not

certainly determined. Some believe that a micro-organism, the bacillus fœtidus, is the real cause. Others attribute the disorder to venous engorgement due to cardiac weakness; to the effects of intractable sinusitis and to neglect of proper treatment for rhinitis in its other forms. Whatever the cause may be, it leads to atrophic changes in the mucosa and submucosa, with destruction of many of the glandules, and the loss of their secretions produces the harsh dryness of the passages, which is a well-marked symptom. The ciliated epithelium disappears and its place is taken by one of squamous type, while some of the destroyed cellular layer is gradually replaced by a network of fibrous tissue of low vitality. Occasionally, there is atrophy of one or more of the turbinate bones. The indications for treatment are to dislodge and remove the crusts and then to thoroughly cleanse the intranasal surfaces and counteract the ozænal odor by irrigating with a detergent, alkaline solution. Crusts hard to detach can be disintegrated with hydrogen peroxide, used a few drops at a time, by means of a cotton-tipped applicator. It cannot be applied freely because the active effervescence, produced by its reaction with pus, might drive some extremely septic material into the sinuses. As a deodorizer, a lotion of one grain of potassium permanganate in half a pint of water will be found very efficient. The fossæ should be irrigated with this solution by using the soft, all-rubber, ear syringe. The most valuable treatment to follow the cleansing process is the graded application of iodine in glycerine, as detailed in a former paragraph. This often checks the atrophic process and there may even be some repair of tissue. The iodine appears to exert its strong antiseptic powers upon the putrefaction and also to induce catabasis of the fibrous elements, which are accumulating to form connective tissue. Their removal gives opportunity for the regeneration of the normal cellular structure of the parts. For home treatment, the patient may use, with the all-rubber syringe, a wash made by adding half a fluidram of the tincture of iodine to a pint of the normal salt solution.

Vaso-motor rhinitis, autumnal catarrh, rose cold, hay fever, are synonyms designating a peculiar form of intranasal inflammation with great vaso-motor relaxation, so that the blood vessels are turgid and there is œdema, soreness, itching and profuse leakage of serum. The conjunctiva is affected in a similar way, presenting a bright red congested aspect, and there is copious lacrimation. The sensory nerves share in the disorder, becoming so hyperæsthetic that irritation of the most trivial kind will excite violent and persistent sneezing. A psychic element is frequently present, manifesting itself in a restlessness and irascibility out of proportion to the physical discomfort, great as that is. Persons, whose self-control is habitual, may during an attack display an excitability almost hysterical. Another sign of psychic involvement is the fact that the symptoms, at least some of them, may be produced by subjective sensations. In sufferers from rose cold, the neural phenomena are excited by inhaling the fragrance of a rose. Some of these patients will sneeze violently if a rose (which they think natural) is brought close to their nostrils, although the flower may be artificial and devoid of any odor.

Heredity and sedentary pursuits are considered predisposing causes. The chief exciting cause of hay fever, in the opinion of most authorities, is the pollen of flowering plants, floating in the atmosphere and reaching the nasal mucosa in the act of inspiration. The disease is most prevalent in the latter half of August, when this pollen is most abundant, and gradually subsides with the passing of that season. Rose cold occurs when roses are in bloom—the end of May and the month of June—and is explained in a similar way. There are, however, some cases of the disease for which this theory will not account, as they take place during the months when vegetable life is dormant. They are at present unexplained. There is no disease in which the success of prophylaxis is better established than in hay fever; that there are a few exceptions does not invalidate this statement, and prophylaxis is what should be advised whenever it is practicable. The sandy seacoast,

where flowering plants do not thrive, and mountains at an altitude too great for them, are exempt from the malady, except when it is imported from other localities. This is true also of elevated plateaus, whose vegetation is chiefly pines and other coniferous trees. To the list should be added the open ocean with its air free from any contamination whatever. Hay fever usually recurs with clock-like regularity upon the same date each year. If the patient will anticipate that date by a day or two and go to some exempt locality, sojourning there until the end of the period which, in his case, is the usual time of duration, he will escape the attack. He will remain immune as long as he persists in this course and sometimes longer, for several instances have been reported where men, after numerous annual absences, were detained one year at home but remained well, the susceptibility to the disease having been outlived. Many business men, with much practical wisdom, arrange their annual holiday to cover their hay fever period, going either to the White Mountains, or to some barren stretch of shore or spending the time aboard ship upon the high seas. They thus avoid the depression of the annual attack and escape the asthma, which is the malady's most serious sequel.

The plan is an admirable one, but the majority have not the means to adopt it fully, though much may be done by utilizing the customary two weeks' vacation, spending it at some one of the numerous islands upon the Atlantic Coast, many of which are exempt and can also be visited at small cost.

When prophylaxis cannot be made available, recourse must be had to those remedies, whose efficiency has been clinically proved, and used by a master of the art; these will effect a great deal in mitigating the symptoms and in preventing complications, but not much in shortening the course of the disease. Inspired by the success of the diphtheritic antitoxin, Prof. Dunbar of Hamburg administered to horses a substance derived from the pollen of many plants, and then from the equine blood produced a serum called "pollantin" which was given

both as a preventive and a cure for hay fever, and was applied to the intranasal mucosa and to the conjunctiva, as well as hypodermically injected.

This attempt to find a serum treatment, being in accord with the trend of therapeutic investigation, excited considerable interest and elicited some hopeful reports; but the evidence in favor of pollantin is far too scanty to win it a place among accepted remedies and it remains a subject for experimentation. The constitutional disturbance in hay fever may be lessened by the judicious administration of saline laxatives and diuretics, so as to eliminate any waste products detained in the system and to get the tranquilizing effect of detergent treatment. If sleep is much disturbed, chloral hydrate and the bromides should be used in accordance with the established principles of general medicine. Epinephrin chloride is a trustworthy stimulant of vaso-motor contraction, but its effect is so transitory when given internally as to greatly abridge its usefulness. In the strength of 1 : 5000, mixed with a two per cent. cocaine solution, it should be topically applied by saturating cotton pledgets and inserting them over the inferior turbinal where the swelling is often excessive. In a short time marked shrinkage occurs and the obstruction to respiration is much lessened. It is true the relief is only temporary, but it gives an interval for the ventilation and drainage of the sinuses, it encourages the patient, and it makes room for irrigation. This should be effected with an alkaline lotion, like Dobell's or the normal salt solution. The soft, all-rubber syringe may be employed for this procedure which, if carefully carried out and repeated several times daily, does much to mitigate the symptoms and renders the patient far less uncomfortable.

After the acute attack has subsided, careful search should be made for any nasal lesion that may have proved a causative factor. Abnormalities of the septum should be corrected, hypertrophies of the turbinals reduced and polypi removed. Hyperesthetic spots upon the intranasal mucosa should be destroyed with chromic acid or the galvanocautery, under

local anæsthesia. Search should also be made for any constitutional dyscrasia and, if found, proper treatment should be given. In addition, every effort should be made to build up the patient's health by the restriction of stimulants and excitants and the use of nourishing food, exercise and a hygienic mode of life.

CHAPTER VIII

NASAL INFECTIONS

The intranasal tissues, being vascular and sensitive, are apt to be affected, more or less, in a great variety of morbid states. Some change in their appearance and some disturbance of their function enter into the symptom complex of many acute diseases and often prove an aid to diagnosis. For example, a catarrhal congestion of the nasal mucosa is almost invariably present in the first stage of measles and aids in differentiating this malady from some others of the exanthematous group. Where such manifestations are purely symptomatic and dependent upon progressive stages of a constitutional disease, they belong to the province of general medicine rather than to rhinology; therefore, the only infections considered in this chapter are those which affect the nose to such a degree as to produce real local disease, either functional or organic.

Influenza, or la grippe, is an acute, infectious fever which has been common in the United States for thirty years, sometimes comparatively quiescent and then breaking out in severe epidemics, but never wholly absent. For three decades prior to this period it was not seen in this country and had been so entirely forgotten that, upon its resurgence, most people thought that an absolutely new disease had made its advent, a mistake soon corrected by old physicians, who in the middle of the nineteenth century had encountered the same malady under the name "tyler-grip." The disease is endemic in Russia whence, at irregular intervals of time, it spreads over the world and then for long periods disappears. The pathogenic organism is an extremely minute, nonmotile bacillus, which was found, identified and named in 1892. The discovery has not helped to explain the malady's curious migrations, nor aided us in

prophylaxis or in treatment, which are still empirical. A peculiarity of influenza is that the brunt of the attack is sometimes borne by one organ, sometimes by another, hence there have come into use such terms as "nasal grippe," "bronchial grippe," "abdominal grippe."

When the nose is especially affected, the attack begins like a severe case of coryza. The catarrhal symptoms are accompanied by a marked rise in temperature, which reaches an elevation not explicable by the local inflammation. In spite of this pyrexia, the sthenic stage usually seen at the beginning of fevers is wholly absent. From the start, there is muscular weakness and nervous depression and the asthenia is often very pronounced. As inflammation spreads in the nasal chambers, frontal headache comes on and often grows severe. To this is superadded neuralgic pain in various parts of the head and face, a pain whose character is frequently such as to resemble a neuritis of one of the cranial nerves.

The sense of smell is often blunted and may be wholly suspended. The breath-road is obstructed upon one or both sides, because the mucosa has become swollen, and a mucopurulent discharge begins to flow from the congested intranasal tissues. In a short time this discharge is liable to become very profuse.

In a variable time, the symptoms tend to decline, as is the case with most acute, infectious inflammations; but the defervescence in this disease is attended by many irregularities and uncertainties. Spontaneous cure is frequent, but it cannot be predicted with great confidence and, both as to simultaneous complications and as to sequels, influenza is surrounded by an atmosphere of doubt. The patient should not be entrusted to the curative powers of nature alone, but should have the benefit of such therapeutic measures as experience shows to be useful additions to the expectant treatment.

As the nasal inflammation is the local manifestation of a constitutional disorder, there is need for both topical and general treatment and, since asthenia is a prominent factor, absolute

rest is the first thing indicated. The patient should remain in bed and should abstain from all mental, as well as physical exertion. The more complete the quiescence, the less is the tendency to complications. If there is any constipation, calomel in hourly doses of a quarter grain together with a grain of sodium bicarbonate, should be given, until the bowels are freely moved. A mild febrifuge, like the spirit of nitrous ether or the solution of ammonium acetate, proves useful; so also does the hot foot-bath. If there is insomnia, five or ten grains of Dover's powder should be given at night. In light attacks no other medication may be required. When the type is severe, acetanilid and the salicylates are often beneficial and I have had satisfactory results from the mixture of thirty grains of acetanilid with twice that quantity of acetyl salicylic acid, ten grains to be administered at intervals of four hours, until the symptoms are ameliorated. Occasionally pain and restlessness are so marked as to call for a hypodermic injection of a quarter grain of morphia. It is the concurrent testimony of many clinicians that quinine, while not a specific, favorably modifies the course of the disease and shortens its duration. Except in the very mild cases, this remedy should be administered from the beginning until convalescence, in doses of from one to three grains thrice daily, according to the patient's susceptibility to its influence, a matter in which there is much variation.

In the local treatment an important indication is to diminish the engorgement of the intranasal membranes and so lessen the obstruction to respiration and give better opportunity for the drainage and ventilation of the sinuses. The best application for this purpose is a solution of cocaine and epinephrin chloride and the following formula gives the strength ordinarily required:

℞. Cocaine hydrochlor..... gr. v
Liq. epinephrin chloridi..... fl. ℥j
Normal salt solution..... q.s. ad. fl. ℥j. M.

A few minims should be sprayed, or dropped, into each nostril

every three or four hours and, for this purpose, the preparation is entrusted to the nurse. Five minutes after the above application, the nasal chambers should be thoroughly irrigated with normal salt solution and this should be followed by the oleaginous liquid described in the appended formula:

℞. Camphor,
Menthol.....āā gr. v
Petrolat. liquid..... fl. ℥j. M.

This oil should be sprayed into the nostrils with a hand nebulizer, or it may be applied through the vestibule, drop by drop, by means of a rubber top pipette. These successive procedures may be expected to secure free nasal respiration and its concomitant drainage and ventilation for a period of from two to four hours. In addition, the prevention of accumulations of muco-purulent matter and the modification produced by the saline fluid tend to protect the sinuses from infection and to guard the Eustachian tube from the entrance of septic matter. In view of the contagiousness of influenza, the patient should be isolated and as its infection is very readily transmitted by bodily discharges, these, whether from the nose or elsewhere, should be promptly and thoroughly disinfected.

Diphtheria may attack the internasal membranes either primarily, or as a consequence of its development in the throat. Here, as elsewhere, it is characterized by the formation of a fibrinous exudate, or false membrane, which displaces the normal epithelium of the mucosa. This resembles in appearance a fragment of worn, frayed linen and has a dirty gray color and a peculiar odor, for which there is no descriptive name, except "diphtheritic;" but once smelt, it is readily remembered. If the pseudo-membrane is raised with a probe, it transmits to the hand a sensation as of something tough and semi-elastic; and this sensation also is easily recollected. In mild cases this membrane may be the only local manifestation. When the disease is severe, the involvement of the cervical glands and constitutional symptoms clearly indicate the nature of the infection.

The exciting cause of diphtheria is the Klebs-Loeffler bacillus commonly found in great numbers in smears taken from the affected membranes. The discovery of this germ and the consequent introduction of the diphtheritic antitoxin, wrought an entire revolution in the constitutional treatment and so greatly reduced the mortality that this malady, once so much dreaded, has been shorn of many of its terrors. It is the nearly unanimous verdict of the profession that antitoxin should be used in every case and that the patient should be isolated until the membranes are free from the pathogenic bacilli. These sometimes linger after the symptoms have disappeared and when the patient not only appears well, but feels himself fully restored to health. The danger in these cases is not so much that of a possible relapse as of the transmission of the disease. The procrastinating germs are quite capable of infecting other persons and in them may exhibit typical virulence, although they appeared innocuous to their former host. This risk of contagion inheres not only in the cases of incomplete convalescence, but in those of a very mild, ambulatory type, where constitutional disturbance is extremely slight and the only local sign, pointing to diphtheria, is the false membrane. Many of the patients, in whom the disease pursues such a course, are those having a primary intranasal infection, the throat remaining unaffected throughout the attack, and thus a mistaken diagnosis of rhinitis is often made. Liability to this error is increased by the fact that in the muco-purulent rhinitis of childhood we often see a grayish exudate, which somewhat resembles the diphtheritic pseudo-membrane. When this, which is the most characteristic sign of diphtheria, has been simulated and perhaps also located where examination is difficult, it is not strange that many mistaken diagnoses have been made. Certainty can be reached only by bacteriological tests and, in view of the danger of spreading infection above noted, such tests should be resorted to whenever there is ground for uncertainty.

Local treatment of the nasal form of diphtheria is an adjuvant to constitutional serum therapy and has in view the protection of the mucous membrane and its restoration after morbid changes. The false membrane should be gently detached and the nasal fossæ irrigated with a lotion made by adding fifteen minims of the tincture of iodine to a pint of the normal salt solution. This will often suffice, but when further alterative and astringent action is indicated, the powdered thymol-iodide (aristol) may be applied to the intranasal mucosa by means of an insufflator.

Syphilitic infection of the nose may present the phenomena of any of the malady's three stages: primary, secondary, or tertiary. The spirochæta pallida is generally regarded as the exciting cause and this germ is believed to be present in every case, though its minute size may make it hard to find. Persevering search for the protozoan is more important in this disease than in most others, because an irrefutable diagnosis is frequently a matter of great moment, not only for its medical bearings, but also from the social and legal points of view. The primary lesion of syphilis is comparatively rare in the nasal region. It is occasionally seen upon the mucous membrane near the vestibule and the virus has been carried, it is alleged, by an unclean handkerchief, by the roller towel suspended in the common wash room of inns and boarding houses and even by the nozzle of a nasal douche, handled by unclean fingers. The possibility of a primary lesion must be borne in mind, when an intranasal examination discloses a sore of unusual appearance. The hard chancre, here as elsewhere, shows at the beginning an indurated elevation with flat top and a smooth, shiny, red surface. This soon breaks down into an ulcer which has marked induration of its edges (a pathognomonic sign) and whose center is covered with a yellowish-gray patch of disintegrating cells and other débris. The submucous infiltration causes swelling, which impedes respiration and may produce external bulging upon the affected side. There is always enlargement of the cervical

and submaxillary glands and frequently headache and some fever.

The chief manifestation in the secondary stage is syphilitic coryza. This resembles the nonspecific type and hence its true character is frequently not recognized until the advent of the tertiary stage with infiltration and necrosis makes plain the diagnosis, when it is too late to prevent irreparable damage Syphilitic rhinitis is much more obstinate than the simple form and there is more tendency to the oozing of blood. When a case is unusually chronic and treatment produces little effect, especially when the discharges are habitually blood stained, the physician should make careful search for syphilitic manifestations in other parts of the body and for any particulars in the family or individual history which may bear upon the etiology. The intractable rhinitis of infants, the so-called "snuffles," is of syphilitic origin, and nasal affections among young children of poor physique when they become chronic should always excite suspicion and prompt a search for the specific germ. In cases of doubt, recourse should be had to the Wassermann and Noguchi reactions for syphilis and, as these tests require much skill, the very best laboratory aid should be sought.

The lesions of tertiary syphilis are those most frequently encountered in the nose and they are responsible for those extensive destructive changes which sometimes produce shocking deformities, rendering the sufferer a social pariah, not only repulsive but even dangerous, for both miscarriages and fœtal monstrosities have been caused by the sight of a noseless man. The first nasal manifestations of tertiary syphilis are often mistaken by patients for nonspecific rhinitis and the physician may not see the case until the necrotic process has begun. If there is an opportunity for examination at the beginning, the true nature of the infection can be inferred from the character of the discharge, which is blood stained and has an unpleasant odor, becoming later on very foul. Besides there is more obstruction than in simple rhinitis,

because the submucous infiltration causes much thickening. In a majority of cases, the intranasal sufaces show those soft, red, nodular swellings called gummata (Fig. 46). These are pathognomonic and mark the beginning of the retrograde changes caused by the disease. A gumma breaks down into an ulcer, encircled by an indurated border, within which is a dark colored mass of pus cells, disintegrating blood corpuscles and other decaying matter giving off a foul odor. The process advances through the submucosa till it reaches the cartilage or the bone, which become necrotic and fragments of which (sequestra) may separate and be spontaneously discharged through the nostrils. When the phenomena occur in this order the diagnosis presents little difficulty, but there are instances in which the disease moves from within outward, primarily attacking the bone, or cartilage, and breaking through the mucous membrane only after their devitalization. In such cases the collateral symptoms and the anamnesis must be reviewed as aids to diagnosis and the finding of the pathogenic germ is highly important, as deciding the question affirmatively; but failure to discover it does not always justify a negative conclusion. Gummata may distend the nasal wall so as to cause an exterior enlargement (Fig. 47).

The disease most likely to be confounded with tertiary syphilis is atrophic rhinitis. In both there is a repulsive odor and crusts are formed upon the intranasal mucosa; but careful examination develops differences sufficient for diagnosis, even without finding the spirochæta. In atrophic rhinitis the crusts are dry, scaly and of a yellowish or greenish color, while parts of the mucous membrane not yet enveloped have a pale, shrunken appearance. When crusts are removed, the underlying tissue, either osseous or cartilaginous, shows only atrophic changes, such as ischæmia and shrinking. In syphilis, the crusts are grumous and colored dark by disintegrated corpuscles, while blood oozes from cracks in their surface. The crusts rarely cover so large a part of the intranasal area as in the other disease, and the surrounding mucosa

FIG. 46.—Ulcerating gummata of the nasal septum; a manifestation of syphilis in its tertiary stage.

(*Facing page* 106.)

is moist, darkly red and swollen, frequently presenting side by side all the stages of ulcerative change. Beneath the crusts the bone and cartilage, if already involved, show the rough irregularities of structure and the perforations which are the familiar evidences of necrosis. These differences together with signs of syphilis in other parts of the body are usually sufficient

FIG. 47.—Gummata of the nasal bones causing disfigurement.

for diagnostic purposes, even without the aid of bacteriology, which, as above remarked, should be obtained if possible.

The topical treatment of syphilitic lesions must be carried on in conjunction with the constitutional therapeusis which is our main reliance. Mercury and potassium iodide have for

many years been considered our most trustworthy remedies for impressing the whole system, the iodine salt being specially useful in the tertiary stage. Recently Prof. Ehrlich's salvarsan (paradiamidodioxyarsenobenzol dihydrochloride) and neo-salvarsan which is a modification of the former, have been very widely used, but have not rendered the older remedies obsolete.

Rapid mercurialization which should be effected as soon as the diagnosis has been made, is brought about by daily inunction with unguent. hydrarg. ℥j. The ointment is applied successively to the right and left armpit, the groins and the loins, one region being used each day of six and the process being repeated in the same order. The slightest sign of tenderness of the gums signifies that a constitutional impression has been made and the treatment can be interrupted. The systemic impression can also be made by giving the protiodide of mercury in quarter grain doses, three times a day, and adding daily another fourth of a grain, until the gums indicate that the remedy is taking effect. Then the dosage should be reduced by one-half and the treatment continued upon that basis.

The administration of iodide of potassium follows, in general, the same method. It should be given at first in small doses and these should be progressively increased, until there appear the first indications of the drug's physiological effect, when the quantity should be lessened and afterward regulated by the circumstances attending the case.

The local treatment of gummata, before the ulcerative process has begun, is directed to the maintenance of intranasal cleanliness, so as to coöperate with the constitutional remedies, which are acting through the blood. Irrigation with an alkaline solution like the normal salt, or Dobell's, fulfills this indication. When ulcers have formed, they should be cleared of pus and detritus with a detergent lotion and then touched with a solution of silver nitrate; a dram to the fluidounce. In the tertiary stage, all necrosed bone should be

carefully removed with cutting forceps, after sufficient anæsthesia has been secured with cocaine and epinephrin chloride. Spots, where putrefactive action is taking place and foul odors are given off, are best treated with thymol-iodide (aristol), the powder being applied to them with an insufflator.

Tuberculosis in the nose is usually secondary to an infection of the throat or lungs, but sometimes primary. Its essential feature is the tubercle which upon the intranasal surface presents the same appearance and runs the same course as elsewhere. These nodules commonly appear in groups (granulomata) and, for a time, give the patient little inconvenience, as they are not painful and at this stage cause no discharge. Frequently no medical treatment is sought until the ulcerative process is established, when there is a muco-purulent discharge, together with scabs and crusts near the vestibule and perhaps perforation of the septum. The cervical and submaxillary glands are involved and there is obstruction to respiration, more or less annoying. If a mass of granulomatous tissue breaks down, forming a large ulcer, it may look somewhat like a sarcoma, but the resemblance is not close and the microscope will clear up any doubt. Differential diagnosis from syphilitic ulcerations is more difficult. The following distinctions will usually prevent error. Tubercular ulcers are much more indolent than those of syphilis; they give little or no pain, the others are often accompanied by much suffering; the tubercular ulcers cause little induration, the surrounding mucosa looks almost normal and the discharge has little odor. In all these respects, the syphilitic sores present precisely opposite conditions. Tuberculosis usually attacks the cartilage of the septum; syphilis preferably some one or more of the bones. If there are cutaneous manifestations simultaneously present, they will give aid in the diagnosis, for the tubercular affections of the skin have an aspect quite different from the syphiloderms.

Treatment consists in measures indicated by the constitutional disease and the hygienic regimen which now plays such an important part. Locally, anæsthesia should be induced by

cocaine and epinephrin chloride and then all diseased tissue should be removed by the curette or destroyed by a fifty per cent. solution of lactic acid. The granulating surface left by these procedures is advantageously treated with thymol-iodide (aristol) or by pledgets of iodoform gauze, so applied as to exert slight pressure. In some instances, it is best to cauterize the whole of the affected surface with the loop of the galvanocautery.

CHAPTER IX

THE NASAL SINUSES

The accessary sinuses, a skiagraph of which is shown in Fig. 48, are cavities with osseous walls, lined by mucous membrane,

FIG. 48.—Skiagraph of the nasal sinuses in a living subject. (*Leonard.*)

and having small openings into the nasal fossæ. In size and shape they exhibit many variations, congenital or develop-

mental, and sometimes one or more of them may be lacking, their absence being discovered only during some operation, or even at a necropsy. In view of these facts, anatomical statements must be taken with the understanding that they refer to what is usual, but by no means universal. According to most authors, there are four sinuses; a fifth is added by some. They are named from the bones of which they are concavities, frontal, maxillary, sphenoidal and ethmoidal. The first two, having outlets into the middle meatus, are called anterior, the other two, which open into the superior meatus, posterior. It is customary to speak of these cavities in the singular number, as we say the frontal sinus, not sinuses, but it must be remembered that they exist in pairs and when we reckon their number as four, we mean four on each side of the median line.

The functions of these air chambers are not positively determined; physiologists say that they promote the resonance of the voice; that they defend the brain against shocks by decreasing the effect of mechanical force transmitted from the bones of the face; that they serve to lessen the weight of the osseous framework of the head without impairing its strength. Whatever uncertainty may exist as to their physiologic utility, there is no doubt whatever regarding the harm they are capable of doing. Their mucous lining is continuous with that of the nasal passages and inflammation, both catarrhal and infectious, readily passes from one to the other. The orifices of the sinuses are mostly small and have only enough capacity to provide drainage for the normal secretions; when to these are added the products of inflammation, the channels of escape are soon clogged, become inflamed themselves, and convert the cavity into a closed chamber, deprived of drainage and ventilation, a nidus for infective, septic and putrefactive processes. Whether diseased action begins in the meatus and extends to the sinus, or starts in the sinus and hence spreads to the open passages, such obstacles are created as make impossible the sanitation of the nasal region and morbific agents, which would otherwise be of little moment, are rendered exceedingly harmful by

the obstruction that nullifies every effort of the organism to cast off pathogenic substances. Here, as in so many other instances, it is the obstruction which is by far the worst factor in the situation.[1]

The ethmoidal sinus differs from the others in being a series of cells occupying small depressions in the ethmoid bone; on this account, some recent authors have designated it the ethmoidal labyrinth. There is much variation in the number and arrangement of these cells; those located posteriorly drain into the upper meatus and are by some named the posterior ethmoidal sinus, constituting with the sphenoidal sinus the "posterior group" of Hajek. The few (two to six) cells placed before these, and which are connected with the middle meatus are, under this classification, placed together with the frontal and maxillary in the "anterior group." Writers following this authority add a fifth sinus to the list by designating these cells the anterior ethmoidal sinus.

It is a very significant anatomical fact that the openings leading from the middle meatus to the frontal sinus, to the maxillary sinus, and to these anterior ethmoidal cells, are all near together; all these cavities drain into the infundibulum and, if it be affected by disease, the morbid condition very readily extends to each of them, so too, obstruction here occludes them all. The middle turbinal and the contiguous structures, extending from the center of that body through a radius of fifteen or twenty millimeters constitutes a nosogenic region (Fig. 49) in which occur the first manifestations of many morbid processes, that subsequently extend to other parts of the nose, and particularly the sinuses. Here is the starting point of nearly all cases of sinusitis, except those affections of the maxillary sinus, which are of dental origin and in these also permanent relief

[1] It is related that, in a postprandial speech, a distinguished laryngologist said, "So continually are we confronted by morbid conditions due to obstruction that, as the Roman Senator Cato closed each of his orations with the words, 'Carthago est delenda!' so I would wish, in every lecture, to put the greatest emphasis upon the supremely important dictum, Obstructio est delenda!"

requires the making and maintaining of a drainage route into the middle nasal fossa.

The etiological fact just stated is the basis for a general plan of treating diseases of the sinuses which, though subject to some exceptions, hereafter specified, applies to the great majority of cases. This plan contemplates procedures of four kinds, progressing logically from the slighter to the more radical; the principle governing, from first to last, being to carry surgical in-

FIG. 49.—The nosogenic region of the nose.

terference as far as is necessary, but no further. Expressed in the briefest way, the treatment included in the first procedure comprises correcting septal deflections and deformities, reducing hypertrophies, normalizing tissues which have suffered from chronic rhinitis, and taking care that teeth and gums are in a healthy condition. In a proportion of cases, this proves sufficient and restores the sinuses to a normal state. The second procedure ablates the tissues within the nosogenic area, opening up routes for drainage and ventilation. This effects many cures. The third method, used where the others have

failed, cuts through the walls of the sinuses from their intranasal aspect and thoroughly removes all diseased tissues and morbid products. This radical operation is often successful. The few cases which have not been amenable to any of the foregoing, demand the use of the fourth and ultimate expedient: opening of the cavities from the exterior, the final resort of rhinological surgery.

The symptoms, which point to engorgement and obstruction in the nosogenic area, are persistent fronto-ocular pain with more or less visual disturbance, and marked tenderness, when pressure is made upon the lachrymal bone; with these may be associated neurasthenia and mental dulness or cloudiness. If there is an accumulation of pus in the ethmoid cells and it does not find a downward outlet, it may push the adjoining wall of the nose toward the septum and a rupture may take place into the orbit, giving rise to orbital cellulitis and exophthalmia. If the protrusion of the eye is due to this cause, there will be the fluctuation characteristic of imprisoned pus. From the orbit, the purulent accumulation may find its way backward among the intracranial membranes and cause meningitis. If the pus escapes downward, there results the condition of open empyema, which is much more frequent than that just described. Diagnostically, the presence of pus in the middle meatus would indicate that it had come from the anterior ethmoidal cells, the frontal sinus, or the maxillary sinus. As the orifices are near together, one of the cavities, two, or even all three may prove to be pyogenic. The differentiation of the sources depends upon other signs. If pus appears in the superior meatus, it originates in either the sphenoidal sinus or the posterior ethmoidal cells.

In accordance with the fourfold plan of treatment, outlined above, the first procedure is to correct any septal deflections, remove spurs, ridges and hypertrophic enlargements, in addition to thoroughly cleansing the nasal passages. A week or more should be allowed to secure the full effect of these measures. They may prove all that is necessary; obstacles having been

removed, the natural reparative forces may accomplish the cure. If this does not occur, the work already done paves the way for the second procedure, the ablation of the tissues within the nosogenic region.

An instrument well suited to this operation is the ethmoid knife (Fig. 50) which has two flat blades continuous with shanks fitting into a common handle, which diverges from them at an angle of 100 degrees. The blades have the shape of long quadrilaterals and are so ground that, when lying before one, side by side, their backs are in contact and the edge of one presents to the right hand and of the other to the left hand. About eight millimeters from the end, each blade is bent at a right angle; the result being that the incision which the blade makes under the force of pressure from back to edge (without traction) has the

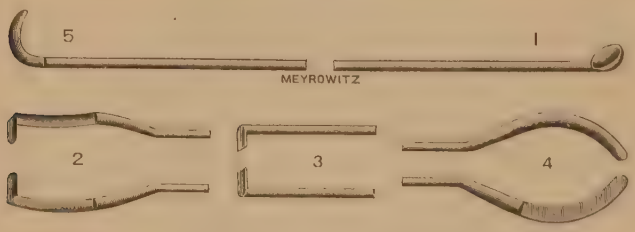


FIG. 50.—Ballenger's ethmo-turbinate knives.

form of a letter L. If the operation is to be performed upon the left side, as illustrated by Fig. 51, the surgeon fixes in the handle the blade whose edge is toward his right hand, then after local anæsthesia has been induced and the left nostril distended by a self-retaining speculum, he introduces the blade with its back toward the septum and advances it along the sulcus of the middle meatus until its bent extremity comes in contact with the sphenoid bone, at the posterior boundary of the space. When the knife is in this position, its handle extends across the right cheek in a line nearly horizontal and a little above the plane of the lips. The blade is now pressed against the tissues confronting its edge, its longer segment entering at the lower margin of the middle turbinal and the upright terminal seg-

ment cutting the ethmoid cells free from their attachment to the surface of the sphenoid. The incision of the cell walls often elicits a peculiar crepitant sound. In directing the knife, the surgeon uses carefully modulated force and an oscillating movement. After detachment at bottom and rear has been effected, the handle is revolved through an arc of ninety degrees, to a perpendicular position in front of the chin; this movement rotates the blade, turning its edge upward toward the ridge of the

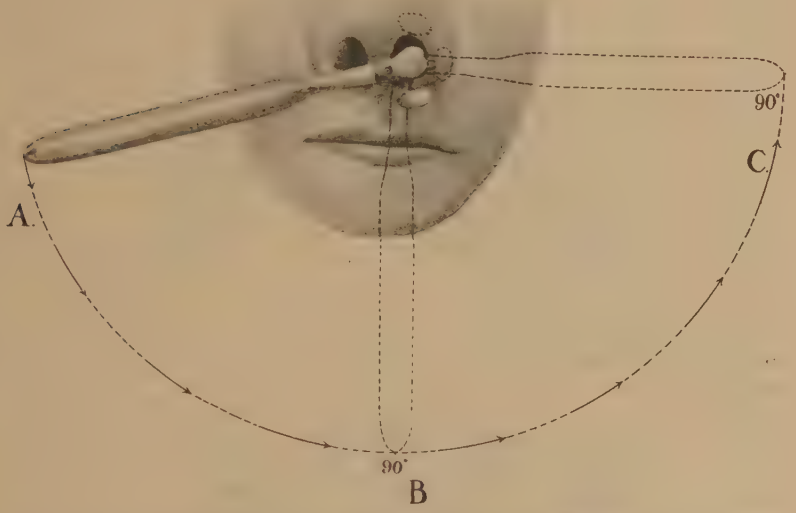


FIG. 51.—Operation upon the nosogenic region in the left nostril. The handle of the knife describes an arc of 90° from *A* to *B* and another of equal length from *B* to *C*.

nose; a vibratory cutting motion brings the blade through the tissues joining the excised mass to the outer nasal wall, as shown in Fig. 52. Then the handle describes another arc of ninety degrees and comes to rest horizontally across the left cheek; this final rotation brings the long segment of the blade on top of the detached body and the short segment, pointing downward, directly behind it. The knife is now withdrawn, bringing with it, *en masse*, the middle turbinal, the ethmoid cells and all

morbid products accumulated in the nosogenic region. Fig. 53 depicts a mass removed by this procedure. The operation upon the right side is performed with the other blade of the

FIG. 52.—The stage of the nosogenic region operation, when the knife handle is nearly perpendicular in front of the chin. The right nostril is shown in this figure.

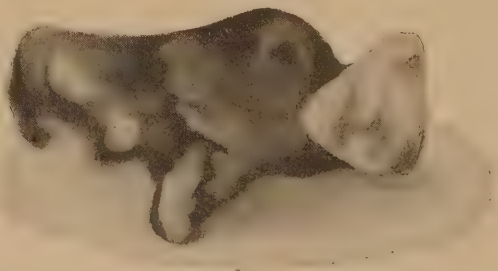


FIG. 53.—Morbid mass removed from the nosogenic region. It includes the hypertrophied middle turbinal, the ethmoid labyrinth, in a pyæmic condition, and polypoid growths. This mass had exerted so much pressure upon the nasal wall as to cause the deformity termed "frog face."

ethmoid knife and is, in all respects, the converse of that just described.

When the ethmoid knife has severed all attachments, the

whole morbid mass may be withdrawn as the instrument comes out of the nose, a very neat and satisfactory result. If this is prevented by some strands of uncut tissue, they should be localized with a blunt probe and then severed with a guarded bistoury or a blunt hook, sharpened upon the concave side. When the mass has been wholly dissevered, it is carefully withdrawn with dressing forceps. The resulting cavity should now be thoroughly inspected and any shreds or fragments of diseased tissue removed with the curette, scissors, or biting forceps. If bleeding is not profuse, it can be controlled by sodium perborate carried to oozing spots upon a cotton-tipped applicator. This is often sufficient, but where capillaries of some size have been severed, the styptic salt may be washed away before a clot forms, and the hæmorrhage continue; when this happens, the cavity should be packed with a long strip of iodoform gauze in multiple folds, leaving a free end by which the fabric may be withdrawn when no longer needed. The packing should be removed as soon as it can be dispensed with, inside of twenty-four hours, if possible, for prolonged sealing up of the intranasal cavities is always attended with the risk of infection and meningitis. During this first day, the patient must remain in bed, in a condition of physical and mental quietude. Afterward, the cavity left by the operation must each day be cleansed with a warm (110° to 115° F.) antiseptic solution and insufflated with thymol-iodide powder, until the raw surfaces heal by granulation. If exuberant granulations appear, they must be reduced by one or more applications of a twelve per cent. solution of silver nitrate or by fused chromic acid. The treatment should be pursued faithfully and patiently, so as to secure from the operation in the nosogenic area the best results of which it is capable. Such a large proportion of sinus diseases are curable by this operation that no detail should be omitted, which may contribute to its success, and it must be remembered that, if it fails, our only alternatives are operations causing more serious laceration of the intranasal structures, or those external incisions which may lead to disfigurement, all

of these involving more danger than attends the conservative procedure which has just been described.

When, as sometimes occurs, a purulent accumulation in the ethmoid cells points into the orbit, it is necessary to proceed from the outside by making a curvilinear incision through the eyebrow, at the root of the nose, taking a direction forward and downward, separating the soft parts from the bone, then, while these tissues are held back by retractors, to search for the opening through which the pus has invaded the orbit. When this has been found, it should be enlarged by a curette, or small chisel, so as to make a passageway down to the ethmoid cells, the course of the excavation being downward and outward. When the diseased cells are reached, they must be broken up and the detritus carefully removed through the artificial channel. This is kept open until its walls are covered by healthy granulations, when it and also the superciliary incision are closed under aseptic precautions.

The maxillary sinus, called also the antrum; or the antrum of Highmore; is the largest of the accessary cavities of the nose and occupies a nearly central position in the superior maxillary bone. It is somewhat conical in shape, the apex being at the malar bone and the base at the outer wall of the nose, at the top, it is bounded by the orbital plate; in front by the facial plate; below by the alveolar process, and behind by the zygomatic surface. The antrum has four anatomical peculiarities, which greatly influence the diseased processes to which it is liable. (1) In most places its walls are exceedingly thin and, although osseous, somewhat flexible; so that under the pressure of imprisoned liquid they become convex, bulging upward into the orbit; and laterally into the nose, or through the cheek. (2) Its only drainage is through a narrow passage terminating in the ostium maxillare, which discharges into the infundibulum; the opening of this passage is near the roof of the sinus so that when the head is erect no liquid escapes by gravity unless the antrum is nearly full. (3) The infraorbital nerve traverses the inner surface

of a segment of the sinus wall, being usually inclosed in a canal, but quite often running along an open furrow, so that the nerve trunk comes into direct contact with any liquid which fills the sinus. When this liquid is septic pus, the nerve is infected and gives rise to intense pain; though this pain is not referred by the sufferer to the antrum, but to the regions in which the nerve terminals are distributed, especially the teeth, orbit and forehead. This erroneous idea of the locality where the pain originates has led to many serious errors in diagnosis and, as a consequence, to treatment both futile and injurious. (4) The roots of three of the upper teeth, the second bicuspid and the first and second molars, sometimes others also, extend into the antrum. These intruding fangs may be enveloped in bony tissue, or in the mucous membrane; but not infrequently they are quite bare and disease of any sort affecting them possesses every facility for spreading through the interior of the sinus. Such transmission is believed to be responsible for fully twenty per cent. of antrum maladies.

Maxillary sinusitis may, at the start, cause few symptoms. The sensations of fullness, weight and discomfort, in one side of the face may attract attention; or may be disregarded, especially by people whose thoughts are much occupied and who pay little heed to sensory impressions. If the infraorbital nerve be involved, there may be intense pain in the eye and forehead and severe toothache, but, with this exception, suffering is not often great so long as drainage continues through the ostium maxillare. When this outlet is closed, there supervene those symptoms which are associated with the incarceration of pus; the sense of weight and a dragging pain, with local heat and some constitutional fever; later on anorexia, thirst and general malaise. Unless there be an outlet for the purulent accumulation, either spontaneous, or surgical, absorption may bring about systemic toxæmia. Among physical signs, the bulging toward the orbit, the nose, or cheek, already referred to, is pathognomonic, but it takes place only when the

disease has made much headway. When rhinitis is synchronously present, the nasal discharges give little diagnostic help and none, of course, after the ostium maxillare has been occluded, but a unilateral discharge of pus, especially if the quantity is greater when the patient lies upon the unaffected side with the head low, hints that the fluid comes from the antrum and this probability is increased if scrutiny with the nasal speculum shows that the pus accumulates in the middle nasal meatus.

Transillumination sometimes proves of much aid in making the diagnosis. This procedure is quite simple, but requires facilities not always available. The patient sits in an erect posture and holds in his mouth a properly guarded and insulated

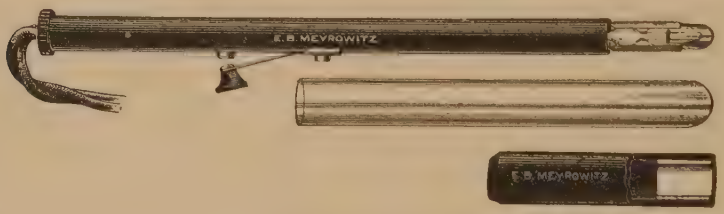


FIG. 54.—Coakley's sinus illuminator.

glass tube or bulb containing a loop, which can be rendered incandescent by an electric current placed under the surgeon's control. The room is then made entirely dark and the electric current turned on. As the tissues of the face including antrum walls are to some degree translucent, they become partially illuminated and, when in a normal condition, transmit many rays and the cheeks are suffused with a peculiar glow. If, however, the antrum on one side is filled with pus, the rays are intercepted and the cheek on that side remains dark. (Fig. 54 shows one of the illuminators in common use.)

When a positive diagnosis of maxillary sinusitis has been made, its cure is to be sought by employing the already described procedures, which culminate in the removal of the diseased tissues within the nosogenic region and by the treatment properly following this operation, draining and irrigating the

antrum through the ostium maxillare. For the latter purpose use is made of the normal salt solution (warm) followed by a lotion containing five grains of zinc chloride in a fluidounce of sterile water.

If, at the end of two or three weeks, we are disappointed in securing a marked improvement, it will be necessary to decide whether our efforts are nullified by some concealed cause of dental origin. I say, *concealed cause*, for any obvious disease of the teeth would have already received attention; because such disease clearly belongs to the group of morbid conditions, which called for correction at an earlier stage of the fourfold plan of treatment herein advised. But a dental trouble, which is the real etiological factor, may be hidden. Caries may have damaged the enamel and dentine of one of the upper molars; the resulting detritus may have been removed and the cavity filled with a mineral substitute, which has satisfied all caleidic requirements and the dentist's task may have been considered finished, and yet there may remain hidden some septic particle, capable, under excitation, of infecting the antrum. When such excitation takes place, sinusitis results and it will continue, as long as the infecting focus remains active.

The proportion of antrum diseases having a dental origin, which is now commonly given as twenty per cent. was rated by earlier rhinologists as high as eighty, or even ninety per cent. The great difference is attributed to the discovery of other etiological factors. It is true that causes not formerly recognized are now held responsible for a great deal of sinusitis, but I think there has also been a decrease in the number of odontopathic cases; a decrease, not only relative, but actual, and that this results from efficient prophylaxis, whose use is due to the coöperation of dentists with medical men. This coöperation has led to much greater intelligence regarding the relations existing between the antrum and the teeth, together with their appendages, and, as a result, much greater attention is given to prevent the interorganic extension of disease.[1]

[1] Laryngologists have rendered a great service in bridging the chasms, which

The decision that the intractable sinusitis is, in part at least, of dental origin, indicates the extraction of some of the teeth whose roots invade the antrum. It is usually sufficient to remove the second bicuspid and the first molar, and their loss, under the circumstances, is not equivalent to the sacrifice of sound living teeth. In the cases here considered, these teeth are nearly always already devitalized and have been the subjects of reparative work. Their condition, when examined after extraction, often shows that they are already far on the road to loosening and spontaneous shedding.

After removal of the teeth, the hole in the antrum floor which had contained their roots, must be enlarged under local anæsthesia by a rongeur or a drill like that shown in Fig. 55. This perforation must be of sufficient size to allow free drainage and thorough irrigation. The normal salt solution answers very well as an irrigating liquid and it should be used once each day until improvement is well advanced; or until it becomes evident that further operative work is necessary. This drainage has the advantage that, when the head is erect, gravity gives much assistance and not infre-

formerly separated scientific workers, who sought the same ultimate object; but approached it by different routes. Aural surgeons have gained the coöperation of the teachers of deaf mutes; a body of capable and earnest educators for a long time wholly isolated from the medical profession and having little sympathy with it. At present, they meet in conferences with otologists, laboring together with them to rehabilitate the deaf and the mutual effort is accomplishing much for the benefit of this class of defectives. So too, the rhinologist has come close to the operating dentist, who in the future may occupy a place beside the gynæcologic and the ophthalmic surgeon, as a practitioner of the healing art, equipped with a general medical education and adding special knowledge and skill concern-with a general medical education and adding special knowledge and skill concerning a particular group of organs; the ideal position of the genuine specialist. In the mean time, the rift grows wider between the dental surgeon and the mechanical dentist, whose post is not beside the patient; but in the work shop. The making of artificial teeth and vulcanite plates will come to be considered a handicraft, highly specialized and remunerative, but nevertheless a trade, side by side with grinding lenses and making supports and braces, occupations producing the mechanical aids required in the professional work of the ophthalmic and the orthopædic surgeons.

quently the antrum thus drained, recovers a condition of health. If this does not occur, the reason is found in the extensive and deep-seated inflammation which has taken hold of the mural structures; or in some constitutional dyscrasia, which impedes the cure. In either case where the patient is tending to convalescence, and also where the sinusitis is recalcitrant, no further surgical procedures should be undertaken from the lower boundary of the antrum. After the elimination of any continuing infection from the dental side, as has been done by the extraction of the teeth and the perforation of the floor, all further measures can be better directed from above the alveolar border on the side of the sinus. The incision through the antrum floor will gradually close by natural repair, plastic work of any sort being very rarely needed. After its closure, the missing teeth may be substituted by artificial ones held in place either by a plate or by bridgework.

FIG. 55.—Cohen's hand drill for perforating the alveolar wall of the antrum.

In the cases where the walls have become so thoroughly diseased that all previously described measures have not been able to put an end to the morbid processes, the sinusitis must be treated by making an outlet large enough for thorough-going surgery. It should be remembered that the ground has been cleared for this operation by the ablation of the tissues in the nosogenic region; so that the intranasal structures have been, as far as possible, restored to a normal condition and the procedure, now to be undertaken, concerns the antrum only. This operation (Cladwell-Luc) is here described, as performed for the cure of the sinus on the left side. The patient is prepared with the same care as for other important procedures and general anæsthesia is induced by the inhalation of ether; the body occupies the dorsal posture, on a table, and the head is turned

over upon the right side. The right nostril is lightly packed, to prevent blood escaping into the pharynx and trachea.

The upper lip, on the left side, is lifted up toward the eye and held in that position by a retractor: this exposes the groove formed by the superior maxillary bone and its coverings joining the lip and cheek, the mucosa of the outer side of the jaw being here reflected over the inner surface of the lip. A short distance below this groove and parallel with it, an incision is made beginning at the median line and continuing past the second premolar tooth, a distance of somewhat more than an inch, and cutting down to the periosteum. The mucosa and submucosa on the dental side are apt to retract; allowance is made for this and the periosteum is divided in a line parallel with the former incision, but slightly nearer the teeth; it is then separated from the bone by an elevator and held out of the way with a retractor. The anterior wall of the sinus is now perforated by a chisel or trephine and the opening subsequently enlarged with biting forceps, or other suitable instrument, until it is large enough for the work required. It may be that visual examination will show an internal condition that necessitates only a small aperture for an inspection by reflected light and for the passage of probes, nozzles, curettes, etc. On the other hand, such a condition may be disclosed, as demands the introduction of the surgeon's index-finger. The amount of bone to be removed must depend upon the indications observed (Fig. 56). In either case the periosteum is protected as far as circumstances permit; at some points it can be drawn aside to remove subjacent segments of bone. The mucosa of the anterior wall, if healthy, is spared as much as possible, being incised and then turned back as flaps attached to the margin of the aperture. By rays reflected from the head mirror, the interior of the antrum must now be thoroughly inspected and, if there are any spots of a suspicious kind, the ocular examination must be supplemented by using probes and even the index-finger. Thorough examination is to be fol-

lowed by removal of all noxious substances, so as to give the reparative forces every possible opportunity to effect a cure. The cavity must be freed not only of all inflammatory products, but of exostoses and other growths springing from the inner surface of the walls. Sometimes lamina of bone are so extensive as to form partial partitions, creating recesses within the sinus. All such obstructions must be broken down, making the antrum a single, vacant cavity. The mucosa and

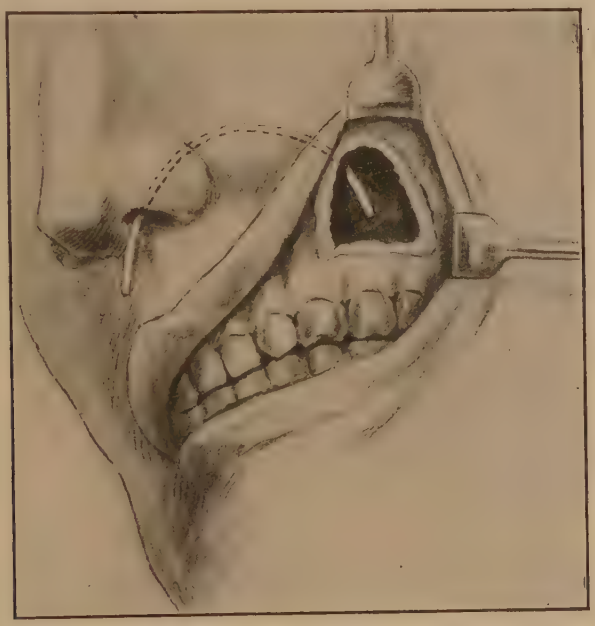


FIG. 56.—Caldwell-Luc operation upon the maxillary sinus.

submucosa, when in a degenerated condition, must be removed with the curette. Care should be taken to avoid wounding the nasal duct and lachrymal canal, and equal caution observed regarding the infraorbital nerve, which passes along the antrum wall; sometimes protected by an osseous sheath, but occasionally lying in an open groove. To provide a route for adequate and permanent drainage of the

sinus, its nasal wall, near the inferior turbinate, a locality within the field of operation upon the nosogenic area, is perforated; a circular piece of bone half an inch in diameter being ablated together with its coverings upon the antral side. The mucosa of its nasal surface is dissected off in small flaps and these are pushed through the aperture where their raw surfaces become agglutinated and form a margin for the artificial orifice. In favorable cases, this opening supplies very satisfactory drainage and ventilation. After the two apertures mentioned have been made and all detritus removed, the preliminary nostril-packing is taken out and the antrum packed by a strip of iodoform gauze, one end of which projects from the left nostril. In a day or two, this gauze is removed and no subsequent treatment is commonly necessary, except daily irrigations with normal salt solution for a short time. The wound of the gum rarely requires suturing.

The frontal sinus, absent in infancy, is gradually developed by separation between the inner and outer tables of the frontal bone. The cavity so produced is over the roof of the orbit, which thus constitutes the sinus floor. The edge of the rift, where the two tables are again in contact, is about half way up the forehead and two-thirds of the distance from the median line to the outer end of the eyebrow, or superciliary ridge; this ridge is caused by the anterior convexity of the sinus, as is also a prominence just above the root of the nose, termed the nasal eminence. The sinus upon the right side is separated from that on the left by a thin osseous plate, or septum, which frequently is incomplete, so that the two chambers communicate. A less common anomaly is an imperfectly developed floor, leaving an opening into the orbit; there may also occur osseous extensions forming partial partitions, within the cavity, and sometimes one sinus is much larger than the other.

The internal surface of the walls is covered by a mucous membrane, with ciliated epithelium, and this continues into

the naso-frontal canal which extends downward to the infundibulum and has its orifice in the middle meatus of the nose. This is the normal route for the drainage and ventilation of the frontal sinus and it often serves as a passageway for pathogenic substances carrying infection from the nostrils.

The symptoms of frontal sinusitis are a sense of fullness and weight above the eyes and frontal headache; the pain is of a neuralgic kind and very often has a peculiar characteristic, which is distinctive. Upon getting up in the morning, the patient is attacked by neuralgia, either of the orbit or forehead; this continues for a variable time, usually an hour or two, and is frequently severe; it then ceases quite abruptly, but returns upon the following morning, reproducing the same phenomena. Whenever neuralgia of this sort comes under our observation, we should make search for disease of the frontal sinus, as it is an almost pathognomonic sign. Its occurrence is explained in this way. The naso-frontal duct is of small caliber and, when the body is recumbent, drainage through its aperture is slow and easily interrupted; much pus may accumulate during the hours of sleep and, in the morning, when the pressure of this liquid comes upon the orbital wall, the supraorbital and other branches of the frontal nerve are irritated, causing the neuralgia. As the patient moves about in the erect posture, the accumulated pus tends to escape through the duct, its discharge being promoted both by gravity, as the passageway is now perpendicular, and by the movements of the head. This outflow at once relieves the pressure and the pain stops. The intermission continues until, during the following night, the sinus is again filled and the symptoms are repeated in the same order. If the duct becomes occluded, these remissions do not occur and the pain is constant, though, as is common in neuralgias, there is variation in its severity.

While drainage is maintained, pus is discharged at the base of the infundibulum and is found upon the surface of the lower turbinal, having oozed into the middle meatus. If obstruction becomes complete, no pus appears in the nostril, but its pressure,

while incarcerated, may be indicated by bulging of the sinus wall above the eyebrow and downward into the orbit.

Treatment of the frontal sinus, as of the maxillary, begins with correction of abnormal conditions in the nasal passages and, as its second stage, ablates the morbid tissues within the nosogenic area. Only in event of the failure of these measures, do we undertake the more radical operations. Sometimes the presence of certain imminent dangers may compel an immediate opening of the sinus from the outside, but, barring such urgency, our next step is taken by the intranasal route, which is always preferable if its use will serve the purpose in view. Though the diagnosis is not likely to involve much difficulty, it is well to employ every aid available and transillumination may be of assistance. An instrument devised for this purpose consists of two small incandescent lamps, each covered by a metal hood having a small aperture at its extremity (Fig. 57). These lamps are mounted on a bifurcated handle with sufficient flexibility to allow of their adjustment, one under each eyebrow. They are also joined by wires, so as to form part of a circuit with a conveniently placed rheostat. In a darkened room, the unhooded spots are applied to the curves under the eyebrows and the circuit is closed, so that the effect upon the two chambers can be compared. If light be transmitted through one and not the other, it signifies the presence of pus in the dark sinus, or else such a thicken-

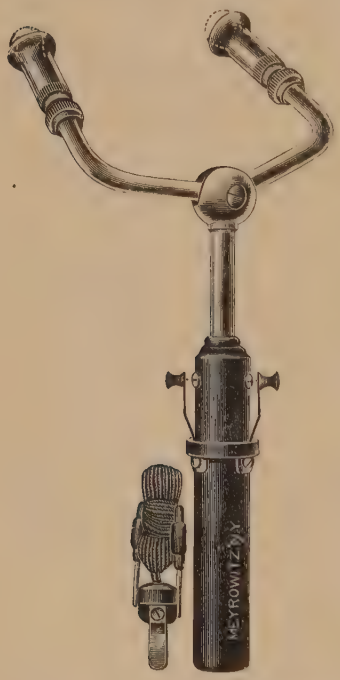


FIG. 57.—Berkett's duplex transilluminator for illuminating both frontal sinuses at the same time.

ing of the walls as cuts off the rays. Skiagraphs may supply corroborating proof of the presence of dense pus or marked hypertrophy of the anterior wall, but a thin liquid will not obstruct the *x*-ray. Both of these tests are adjuvants and should not be given too much confidence, when they are unsupported by other evidence.

The intranasal operation is performed under local anæsthesia and the self-retaining nasal speculum exposes the middle fossa, as in exenteration of the middle turbinal. If during that operation the bulla ethmoidalis and process uncinatus escaped removal, they must now be extirpated by the curette, chisel, or rongeur forceps, and free access obtained to the lower aperture of the naso-frontal duct. A slender probe is then passed up through this duct until the distance of its penetration shows that its point has entered the sinus; as the instrument may be gripped in the curved passage, the feeling of release communicated to the hand, when the probe reaches open space, may not be felt and the surgeon must watch how much of the instrument's length has disappeared within the duct. This catheterization of the duct may prove difficult; because inflammation has made the wall thick and uneven, but its importance justifies patient effort and the trial of different implements; the filiform bougie may prove useful here, as it does in passing through a nearly impervious urethra. When the withdrawn probe is followed by pus, its entrance to the sinus is proved beyond doubt. If even a thread like outflow is established, much has been accomplished; for such a discharge will relieve pressure and, in an hour or two, notably diminish the purulent accumulation, so that nothing further may be advisable at the time.

Upon the following day, with renewal of the local anæsthesia, the duct should be dilated with one of Freeman's graduated sinus probes, or other suitable instrument, and the facility for drainage thus improved. If in repeated sittings the duct can be so enlarged as to admit a small canula (or soft catheter with stillette) through which an irrigating fluid like normal

salt solution, can be injected; no further operation may be required and, with daily sounding, to keep the duct patulous, and daily irrigation, to keep the sinus clean; the case may steadily advance to a satisfactory cure. If sufficient enlargement of the outlet cannot be secured by these means, the probe is used as a guide to introduce a curved rasp (Good's or Sullivan's) backed by a protector of similar curve, to guard against intracranial perforation. The teeth of this rasp, shown in Fig. 58, are upon its concave surface and, acting with a saw-like motion, they make a groove toward the ridge of the nose

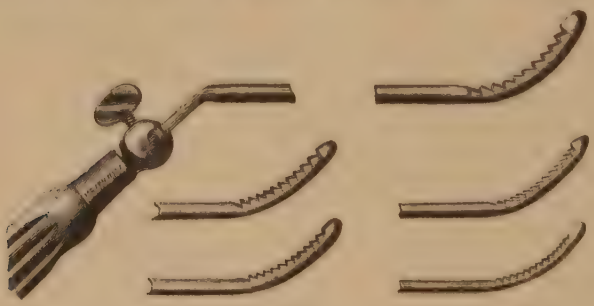


FIG. 58.—Sullivan's frontal sinus rasps.

and parallel with the nasal septum. The rasp cuts away one side of the naso frontal canal and the anterior part of the sinus floor, which is contiguous to its upper orifice. This gives ample room for irrigation, drainage and ventilation, with the sacrifice of only a small part of the mucous membrane of the sinus. Healing takes place by granulation and excessive hystogeny should be prevented by using an eight per cent. solution of silver nitrate, fused chromic acid, or the curette. Immediately after rasping, it may be necessary to pack the channel with a narrow strip of iodoform gauze, to control bleeding, and this dressing can usually be removed in a few hours.

There are but three conditions, which call for a radical external operation upon the frontal sinus: (1) The failure of the intranasal procedures to overcome the disease; (2) a situation which precludes the performance of operations

of an intranasal kind; and (3) imminent peril of complications endangering life or vision. The second condition arises from the obstruction of the fossæ by polypi or other neoplasms, whose presence hinders the intranasal measures described, and whose removal with the subsequent period of recovery would cause a delay longer than permissible, before combating the sinus disease. The third condition includes the symptoms presaging the development of very grave complications: the invasion of the brain membranes and the onset of meningitis; the escape of pus into the orbit endangering fulminating ophthalmitis and loss of sight; a profuse and fœtid discharge with indications of general septicæmia.

A frontal operation (Ogston-Luc) which enters the cavity from the superciliary ridge was designed to remove all morbid tissue, without obliterating the sinus, or greatly diminishing its size. It is done under general anæsthesia. The eyebrow is shaved and the integument for some distance carefully sterilized. An incision is made beginning at the median line, just above the naso-frontal suture, extending almost to the outer extremity of the eyebrow, and going down to the bone, care being taken not to injure the supraorbital nerve. The soft tissues are now separated from the outer table of the frontal bone, with an elevator, and held back by retractors. The proper spot for the perforation of the sinus wall is found by drawing a line parallel with the crest of the nose and perpendicular to this another line passing through the supraorbital foramina; a point one centimeter to the right of the intersection of these lines is the best place to puncture the right sinus, and a point correspondingly situated on the left side is best for the other sinus. This perforation is made with Randall's hand gouge and enlarged with rongeur forceps to a size, which will permit thorough curettement of the cavity. The naso-frontal duct is then enlarged, by curetting its anterior wall, until its caliber is sufficient to insure ample drainage. All ethmoidal cells, unless already removed by the operation upon the nosogenic area, are broken up and their detritus extracted

through the enlarged duct and the perforated wall; the field of operation is freed, as far as possible, from shreds and scraps of incised tissue and then the sinus is packed with a strip of iodoform gauze, one end of which is carried through the naso-frontal canal and left pendulous in the nasal fossa. The external wound is aseptically sutured and covered by a roller bandage lightly applied, as protection against dust, friction, etc.; the gauze packing is removed in four or five days and after that, normal salt solution is used for irrigation, first at daily and afterward at longer intervals, until the reparative process is complete. Our success in this operation is much promoted by extirpation of the ethmoidal cells previously effected, because it is hard to remove them thoroughly by upward carriage from the infundibulum to the frontal floor; failure to do so is the most common defect in this procedure. This drawback, of course, is absent when the operation is secondary, but is always a possible reason for partial failure when the Ogston-Luc method is used primarily to meet emergencies. In favorably ending cases, good frontal drainage and ventilation are permanently established and the disfigurement is not great, there being but little retraction of the perforated table of bone and suture scars being partly hidden by renewed growth of hair upon the eyebrow.

The Killian operation is much more extensive. Preparations, as regards anæsthesia and sterilization, are the same as those described above. The first incision extends from the outer extremity of the eyebrow to the median line, horizontally, and then downward to the root of the nose. This cut goes down to, but not through, the periosteum. The soft tissues are turned upward with an elevator and held by retractors, exposing the periosteum over the whole of the frontal bone upon the affected side; the periosteum is incised in a horizontal line five millimeters above the supraorbital ridge and reaching from the median line to the outer end of the eyebrow, it is then raised from the bone by an elevator over the whole exposed area and held out of the way by re-

tractors. The periosteum is next divided by another incision whose beginning is slightly below the supraorbital ridge, on the nasal side of the supraorbital foramen, and which extends downward and inward to the root of the nose. Here, too, the bone is laid bare by lifting up the skin and all subjacent tissues, including the periosteum, upon the lower and outer side of the incision. After careful separation with the ele-

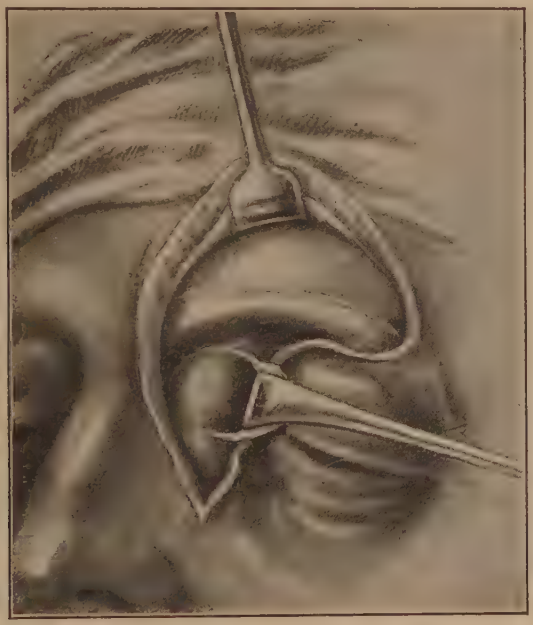


Fig. 59.—Killian operation on frontal sinus: first stage.

vator, the inverted layer is drawn outward toward the temporal bone, partly moving the contents of the orbit in the same direction. The above technique is followed to avoid displacing the coverings of the supraorbital arch and superior oblique muscle (Fig. 59).

The next step is the perforation of the uncovered frontal bone with a trephine or gouge, and ultimately the entire anterior wall of the sinus is removed by enlarging this open-

ing; the cavity is cleared of all bony lamina and the mucous membrane is scraped off; finally a part of the floor is also removed and the ethmoid cells (should any remain) are extirpated (Fig. 60). Hæmorrhage is controlled by gauze packing and, afterward, the extensive raw surface is treated with a one per cent. solution of zinc chloride, and kept open until healthy granulations begin to appear. The periosteum and

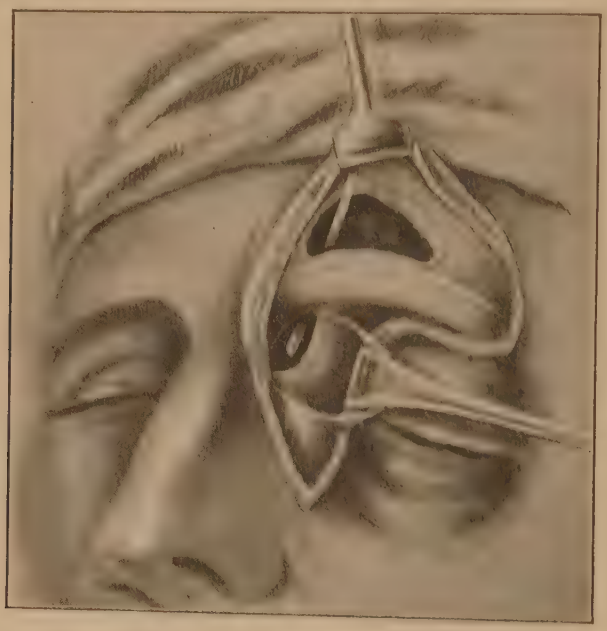


FIG. 60.—Killian operation on frontal sinus: second stage.

skin are now replaced, with as much accuracy as possible, and interrupted sutures inserted. Much care and patience are required during the postoperative treatment, not only by the local conditions, but to keep the organism in the state best adapted to promote recovery after extensive laceration. In time, the remains of the sinus are, to a great extent, filled by connective tissue and by adipose cells extending up from the fat deposits in the orbit. Considerable disfigurement is

apt to result from this operation, due partly to the sutures and partly to the retraction of the skin, which has lost the support of the anterior wall of the sinus; this may show as a permanent, deep indentation.

There has recently come into use a new method of operating upon the frontal sinus for which we are indebted to researches made by Mosher, and which bears his name. This operation was suggested by deductive reasoning, or at least has its full support. Obviously the intranasal route to the frontal sinus is preferable to those requiring external lacerations, if the inner passage can attain our object. The intranasal technique contemplates such dilation of the frontonasal canal as shall restore its normal function as a sufficient outlet for the sinus. Just here is the difficulty. The process of dilation is slow and, when the eye or the brain is imperiled by fulminating disease of the sinus, we dare not wait and must ignore other considerations and make an entrance into the cavity with all dispatch, which has usually meant penetration of the forehead. Even when this urgency is lacking, the method by dilation may disappoint us. The frontonasal canal may be so much damaged by chronic disease that it is beyond repair and, after patient dilation with bougies and even enlargement with the saw-tooth rasp, still fails to perform its normal function and gives the sinus only precarious and intermittent drainage. It is not meant that such a disappointing result is common, but it may occur, to our mortification, in a small proportion of cases where the lumen of the duct is narrowed by incurable strictures. If another passageway, capable of giving free drainage and practicable access to the sinus, can be substituted in place of the outworn frontonasal canal, the difficulty mentioned will be obviated and if, in addition, such substitution can be quickly effected, external operations will be seldom required.

Mosher observed in the wall of the nasal fossa, just above the point of attachment of the anterior part of the middle turbinate, a spot where the osseous partition between the fossa

and the frontonasal duct is extremely thin. He demonstrated that this delicate lamina of bone is easily broken through and its penetration is not productive of hæmorrhage or other objectionable effect. The opening thus made enters the duct very near its upper end, above the range of strictures and close to the superior orifice in the floor of the frontal sinus. The distance, by this route, from the sinus

FIG. 61.—Mosher's operation; the curette has broken through the thin osseous plate into the fronto-nasal canal.

to the corresponding nasal fossa is about half an inch and the course is nearly a straight line. This route can be opened up in a single operation consuming but little time, and when open, it affords access to the sinus for both inspection and treatment and provides constant and adequate drainage.

The operation, devised in pursuance of the conditions described, is performed under either local or general anæsthesia and with the usual precautions as to cleansing and sterilization. The nostril is distended with a self-retaining speculum and a small, moderately sharp curette is introduced with its

cutting edge turned toward the orbit until it reaches a point slightly above the vacancy left by ablation of the anterior part of the middle turbinal, previously removed (see Fig. 43). Here is encountered the thin osseous partition referred to and this is broken through with the curette (Fig. 61). The opening is enlarged sufficiently to afford ready passage for the head of the instrument which is then advanced to the upper orifice of the frontonasal canal where enough space is exca-

FIG. 62.—Final stage of Mosher's operation.

vated to allow the curette to enter the sinus (Fig. 62). The instrument is then partially retracted and the anterior ethmoid cells ablated by rotating the curette head and giving it a to and fro motion. The curette is now advanced toward the sphenoidal sinus and removes the posterior ethmoid cells. The frontal sinus is explored with a blunt probe which, after being wound with cotton, is employed for the removal of any thing which should be extracted, and subsequently the cleanliness of the cavity is assured by irrigation which is effected

by introducing a tube through the recently made mural opening and the natural orifice in the floor of the sinus. The only dressing usually required is a pledget of sterile gauze and the raw surfaces, left by the curette, heal in a short time by granulation. As free drainage takes place directly into the nasal fossa, the frontonasal canal is superseded by the new passageway, and the cessation of its functional activity becomes a matter of minor concern. It requires no further attention, except such as is necessary to prevent it from becoming a nidus for germs, or playing some other nosogenic part.

Theoretically, Mosher's operation fulfils the indications calling for opening of the frontal sinus in an admirable way and that too with but little surgical interference and a minimum of laceration. Its technique has the marked advantage of being simple and direct. The period that this procedure has been in use is too brief to justify conclusions as to secondary and remote results, whose character can be known only after the lapse of a considerable time, but so far as judgment may be based upon experience already gained, I esteem the operation highly and consider it a valuable addition to our surgical therapeutics.

The sphenoidal sinuses are situated near the center of the sphenoid bone, one on each side of the osseous lamella, which articulates with the perpendicular plate of the ethmoid bone, and thus constitutes the posterior segment of the nasal septum. In size and shape they exhibit so much diversity that they can hardly be said to have a normal type. During infancy they are absent, their development beginning in childhood and continuing until the thirtieth or fortieth year, when they attain their full size which remains unchanged to the end of life. One of the sinuses is usually larger than the other and the two often communicate through openings due to imperfect development of the osseous partition. Like other sinuses, they are lined with mucous membrane and each has but a single outlet, the osteum sphenoidale, which communicates

with the superior meatus of the nose. As this opening is on the anterior side of the sphenoid, it cannot be seen by posterior rhinoscopy and it is also hidden from a front view by the middle turbinal. After this and the contiguous structures in the nosogenic area have been ablated, it is possible, though not easy, to examine the osteum from in front by rays of reflected light. The posterior ethmoidal cells are near by and may be seen at the same inspection, unless concealed by irregularities upon the surface of the sphenoid bone.

Whatever drainage and ventilation the sphenoid sinus has, must be through this osteum and its occlusion gives rise to the usual dangers of obstruction with the addition of one which is peculiarly distressing, the peril of blindness. Each sphenoid sinus is traversed by the canal ensheathing the optic nerve of that side. This canal is fragile and sometimes incomplete so that the nerve is liable to injury from purulent accumulations within the cavity. Sometimes optic neuritis thus produced runs such a rapid course that irremediable blindness is produced within a week, though these fulminating cases are mercifully rare.

The signs of sphenoidal sinusitis are (prior to obstruction) the discharge of pus into the upper nasal meatus and headache referred mostly to the cerebellar region. The pain is neuralgic, wandering, and more or less intermittent. In considering the question of ocular symptoms, it must be borne in mind that the optic nerve transmits visual sensations, not those of pain, hence its danger signal is not algetic but dysoptic. Progressive dimness of vision, especially if unilateral, even if attended by little pain, demands an immediate investigation of the sphenoid sinus: should it be found inflamed, the eye symptom is of the gravest import. There is no time to lose: when something so deplorable as blindness is threatened, all details not absolutely necessary must be omitted, for the sake of dispatch. With the patient under general anæsthesia, the osteum is to be exposed to view and, if necessary, dilated by the introduction of Ostrom's sphenoidal forceps (Fig. 63). The instru-

ment is advanced into the cavity and when its point has entered the sinus, the jaws are opened to seize a segment of the anterior wall which is bitten out by a backward movement of the cutting edge, as the handles are compressed. By repeating this manœuver, the entire front wall is cut away, bit by bit. The bone is sometimes over a quarter of an inch in thickness, but the instruments are strongly made and quite capable of doing the work. All accessible cells of the posterior ethmoid group

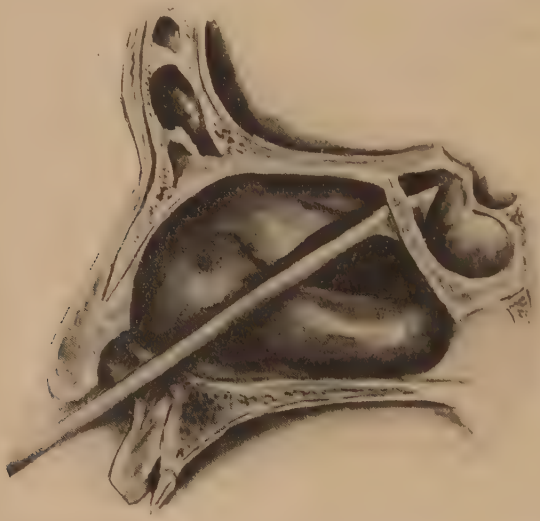


FIG. 63.—Operation upon the sphenoid sinus. Ostrom's forceps *in situ*.

must be removed with the curette, the sinus cleansed and disinfected, bleeding being controlled by the usual gauze packing. Of course, every care is taken not to injure the optic nerve. Postoperative treatment is upon the same plan as that followed with the other sinuses.

It is an encouraging fact that this operation, if performed at an early stage of the optic neuritis, nearly always leads to its arrest, and has undoubtedly saved the sight of many eyes. In view of this, early diagnosis is of paramount importance and it would be a wise precaution to examine the sphenoid sinus in

every case of amblyopia whose causation is at all doubtful. Sinus disease may exist without producing any nasal symptom sufficiently prominent to attract the attention of the patient who seeks medical aid solely on account of his eye trouble. An oculist sent me a patient suffering from intractable optic neuritis. The clinical history contained nothing to suggest involvement of the sphenoidal sinus, except an attack of coryza sometime before, but examination disclosed a latent empyæma. I operated upon the sinus and the posterior ethmoid cells. Vision then began to improve and, in a few months, was fully restored.

CHAPTER X

NASAL DISFIGUREMENTS

The nose is so prominent among the features of the human face that abnormalities of color or shape, even when slight, attract attention and when marked are peculiarly unsightly. These abnormalities may or may not be associated with serious disease, organic or functional, but as their common characteristic is their unsightliness, it is better to designate them as disfigurements than as deformities, for in the class of deformities there are many lesions, such as septal hypertrophies and various neoplasms which may make no change in the external appearance of the nose. Those afflicted with pronounced nasal disfigurements sometimes suffer serious injury to their health even when the lesion does not impair any rhinologic function. By constant brooding over their misfortune, they become obsessed with the idea that everyone considers them repulsive and wishes to shun their society, and they misinterpret the trivial incidents of daily intercourse in accordance with this obsession. They become neurotic, morbidly suspicious and approach a condition of mental unsoundness. Such patients deserve sympathy, not due to the vain egotists who go about seeking the removal of some slight blemish to their overprized beauty. A patient of the latter sort is apt to give the physician much trouble, for no matter how judicious his treatment has been, she will be dissatisfied; will criticise him among her acquaintances and will make trial of another doctor. After a time she is likely to fall into the hands of some charlatan who will mislead her with promises of impossible results, as long as her money holds out.

Cutting operations, which have such importance in general surgery, play but a small part in the treatment of nasal dis-

figurements and rhinologists have felt the need of an appellation which would be accurately descriptive and several text books use the words "cosmetic surgery." The term *cosmetic* is objectionable; it is alien to scientific nomenclature and is suggestive of soaps, perfumes, the manicure and the "beauty doctor." In public estimation, the cosmetic surgeon is akin to the chiropodist, and the name should be replaced by one which is both significant and dignified. Caleidic (kalos + eidos: comely + form) is a substitute for cosmetic which correctly expresses the idea and is analogous in derivation to other medical terms.

Among the disfigurements due to abnormal coloration is that caused by long-continued abuse of alcohol. From the bridge downward the nose is red, the shade growing darker until upon the tip it is nearly purple. The tip is enlarged and bulbous, while there is much thickening of the alæ nasi, also rugosity of the skin due to permanent distension of the cutaneous capillaries.[1] Such noses were formerly a very common sight upon our streets, but for some reason are now seldom encountered. When of long continuance the condition is incurable, but at an early stage, when there is but slight degeneration of the blood vessels, much good can be done, provided the abuse of alcohol is stopped. Men, who have overcome their intemperate habit, are very anxious to be freed from this sign of their former weakness and are willing to follow instructions faithfully and patiently, a strong point in their favor. Good hygienic conditions are important and such constitutional remedies are indicated as will promote elimination and prevent hæmic congestion and stasis. Topically, massage will help to conserve and restore the elasticity of the walls of the distended capillaries. Moderate bilateral pressure applied for ten or fifteen minutes, three or four times during the twenty-four hours, is

[1] In the following lines of mocking satire, the German students have likened the red, swollen nose to a crimson banner, leading an army of drunkards:

"Salve vexillum rubentium nasorum,
Signum exercitus ebriosorum!"

beneficial. It mechanically empties the engorged vessels, and though the blood returns after pressure is removed, yet if this treatment be persistently followed for several weeks, there will be observed a gradual diminution in size accompanied by slow fading of the dark red color. The officinal tincture of iodine should be applied over the area of discoloration semi-weekly. Used with long intervals, it does not harm the congested skin and it directly promotes the catabasis of the superfluous cells which should be removed from the subcutaneous tissues. It must be remembered that these measures are recommended only in cases where degenerative changes have not proceeded far. In the last stages of chronic alcoholism, when the nose is nearly necrotic, rubbing, pressure, or any other disturbance may be very harmful.

Large scars upon the surface of the nose are very unsightly. They generally have a white, glistening surface and may be crossed by dark blue lines. Their origin is sometimes traumatic, but most frequently furuncular, their cause being the vicious healing of abscesses which, instead of being lanced, have been "left to nature" and have opened by ulceration through a segment of devitalized skin. The fibrous tissue of such scars has often subjacent attachments to the cartilage, if they are situated upon the alæ nasi, and to the periosteum if near the nasal bridge. These prevent the movement of the skin and the various contractions of the facial muscles, instead of producing change of expression, as they should, cause distortion of the countenance.

Allyl sulpho-carbamide (thiosinamine) has the property of softening cicatricial tissue. It is not very soluble in water, but a five per cent. solution can be made by incorporating twelve grains with two fluidrams of glycerine and the same quantity of water. Four or five minims of this solution should be hypodermically injected at the margin of the scar, keeping the needle nearly parallel with the surface, to avoid wounding the perichondrium or periosteum. If the remedy is soon absorbed, the injection may be repeated each day, a different

margin of the scar being used for the successive punctures. If absorption proves slow, longer intervals must be allowed. Pain is commonly slight; in exceptional cases it may be severe and require the previous injection of a few drops of a four per cent. solution of cocaine. The scar tissue should be rendered soft and flexible by from six to twelve injections. As soon as there is notable alteration, massage should be used with the object of loosening the underlying attachments, restoring the motility of the skin and bringing back the normal color, by releasing the constricted capillaries. Absorption of redundant cellular tissue will be promoted by painting, at weekly or semi-weekly intervals, with the tincture of iodine. These measures, when skilfully and persistently employed, often accomplish much, and though a perfect cure cannot be anticipated, yet the disfigurement and the distortion of facial expression may both be so much lessened that what remains is inconspicuous; when that stage of improvement is reached, the purpose of the treatment is virtually attained.

Eczema and other skin diseases cause discolorations of the nasal integument similar to those observed in other regions, and they call for the same dermatological treatment, with the proviso that appearance is in this locality of far greater consequence than in parts covered by clothing.

Disfigurements due to abnormal shape may be congenital, traumatic, or the result of disease. Extensive destruction of the nasal skin and subdermal tissues is often brought about by syphilis, and here the malady works dreadful ravages. The gaping chasm, occupying the center of the face and extending backward nearly to the naso-pharynx, is repulsive in the last degree. When such devastation has been wrought, the only hope is in a plastic operation. To secure a sufficient supply of plastic material, without dangerous mutilation in other quarters, is a difficult factor among many embarrassing conditions in these reparative procedures. Each case presents so many features peculiar to itself that it is very hard to generalize, beyond the statement of two principles which are applicable

to all operations of this class. First, strict asepsis is necessary, because there is much danger of infection where the area of raw surfaces is large and second, the plastic graft, whencesoever it be taken, must have an attachment to the tissues of its natural situation, which will give it an adequate supply of blood while it is forming connections with the raw surfaces in its new locality. Failure to provide for this makes the death of the graft inevitable and imperils the success of the whole operation.

Disfigurements which do not involve destruction of the integument offer a more hopeful field for treatment. They may be due to cretinism, or other congenital cause, or may be sequels of tertiary syphilis, which sometimes excavates large cavities in the intranasal region without penetrating to the surface. Being deprived of the natural means of support, the skin together with the subcutaneous tissue sinks down into the underlying cavity. In this way is produced the familiar saddle nose, in which the normal elevation of the bridge is replaced by a transverse furrow, sometimes shallow and sometimes so deep as to be on a level with the zygoma. There are many persons disfigured by this, or similar malformations, in whom the original cause has ceased to act; the morbific agent has been overcome either by treatment or in some other way; the nasal functions are fairly well performed, and the patient considers himself free from disease, but is distressingly conscious of his facial deformity. This group of cases is preëminently the province of caleidic surgery. In recent years, much success has attended the method of raising and supporting the collapsed tissues by injecting a substance which can remain harmlessly in the network of subcutaneous connective tissue, little influenced by gravity and little diminished by absorption. The utility of the method depends upon the fact that nearly all the desired qualities are properties of paraffin. This is an organic solid formed by the union of several different hydrocarbons, in different proportions, and while the ratio of carbon to hydro-

gen is always the same, samples of paraffin differ in physical properties such as density, melting point, etc.

As paraffin melts at a moderate temperature, it can be injected in liquid form; as it is solid in the normal heat of the body, it can serve as a support; its specific gravity, though varying in different samples, is always less than that of water and very close to that of adipose tissue, hence there is no sinking by weight like that occurring with leaden shot and other heavy projectiles; its translucent white color prevents any pigmentation effects; as it is composed of saturated hydrocarbon, it is devoid of chemical affinities, is neither poisonous nor nutritious, and therefore may remain among the living tissues doing no harm and undergoing every little change. The instrument used for its injection is virtually a large hypodermic syringe having the following features: The barrel consists of metal, not glass, and has the capacity of one fluidram. It is strongly made and is armed with a strong, sharp needle of large caliber; the piston is operated by a screw, insuring slow injection of the liquid, drop by drop.

FIG. 64.—The injection of paraffin for nasal disfigurement.

The area of operation having been rendered insensitive by cocaine, the syringe is filled with the paraffin, previously liquefied by heat, and the needle is inserted into the subdermal connective tissue underlying the depression (Fig. 64). If the amount of paraffin needed to restore the natural contour be small, it may all be injected at one sitting; otherwise, repeated operations may be required, and it is better to use too little than too much, for if the filling out is not complete, it is easy to inject

more of the hydrocarbon and the portion added will coalesce with what is already in place, but if too much be injected, it is practically impossible to effect any withdrawal. Bleeding occurring at the puncture may be controlled by pressure with sterile gauze and the opening may then be sealed with collodion. As the paraffin solidifies, the stiffening mass should be modeled into a shape approximating as nearly as possible the natural form of the nose.

Among untoward sequels of this operation there are on record some cases of embolism and thrombosis. They seem to have been produced by the needle's entering a blood vessel, a rare accident when the syringe is in skilful hands. In two published cases the embolus was dissolved by injections of ether and did no harm. There are also reports of infection in a few instances. The only safeguard against such a misfortune is painstaking attention to all details of asepsis, both in preparation and in operating. When the injection is high up, as in saddle nose, there is risk of the paraffin spreading through the loose subdermal tissues near the inner canthus of the eye. This can be prevented by having an assistant, or the patient, make digital pressure on both sides of the nose just below the level of the eyebrow.

It is said that some persons, whose nasal disfigurement had been treated by the injection method, found upon entering the boiler room of a ship, or some other superheated apartment, that the paraffin begin to liquefy, causing partial collapse of the nose; on the other hand, there are complaints that premature solidification of the injected material has prevented satisfactory modeling of the restored organ. Such accidents arise from using paraffin whose melting point is either too low or too high. This substance exhibits great variation in regard to the effect of heat, the different grades having melting points ranging all the way from 120° F. to 200° F. Between these limits are temperatures which would preclude the occurrence of both the mischances referred to, and as the tubes in which paraffin is supplied for surgical purposes commonly bear record of the

melting point upon their label, the rhinologist can provide himself with such a quality as will accurately meet the requirements of his caleidic work.

Operations, in the main successful, are sometimes followed by a partial disappointment, which is due not to any lack of surgical knowledge or skill, but to a want of artistic perception. A saddle nose built up with paraffin may appear of correct outline and, while the features are in repose, no defect is exhibited; but when the facial muscles are thrown into strong action by laughter, or by any emotion of an intense kind, the countenance shows a certain distortion. Something is wrong with the nose; an observer may not be able to tell exactly what the fault is, but he is sure that the face looks unnatural, and from that perception it is but a step to recognize that the most prominent feature is in part a fabrication. The restored organ thus betrays its secret, because its conformation is not in harmony with the other features; it is a well-shaped nose, but it lacks the particular shape proper to that individual face. The minute differences, upon which facial distinctions depend, may not be observed when the features are at rest, but they become impressive during emotional disturbance.

It is said that a rhinologist averted a painful disappointment of this sort by an ingenious expedient, which though of limited applicability is extremely suggestive. His patient, whom he had cured of some intranasal troubles, was a man of great influence in the business world, but took no part in social pleasures because he was morbidly sensitive regarding his saddle nose. The use of paraffin was strongly advised, but he hesitated, for he had heard of incongruous results like those just referred to and he feared to become an object of ridicule. The doctor, whose advice was at last accepted, employed a sculptor who made a thorough study of the patient's features, at rest and in all attitudes of motion, and then made a model in clay reproducing the face, except that the disfigured nose was replaced by one such as the man should have had, a nose perfectly congruous with all the other features. The operation was then performed and

the injected paraffin was moulded to the closest imitation of the nose modeled in clay. The rhinologist's ingenuity and patience led to the happiest results. The patient subsequently made many postprandial addresses and, although his countenance passed through the many changes incident to public speaking, auditors who had not previously known him enjoyed his oratory, quite unwitting that he had once been greatly disfigured and that his present nose was in large measure a work of plastic art.

CHAPTER XI

NASAL RELATIONS TO SPECIAL SENSES

Nasal conditions, functional and structural, have important bearings upon three of the special senses: smell, hearing and sight. The close anatomical relations between the breath-road and the organs of olfaction and of audition has been noted in Chap. I, but the connection of this road with the complex mechanism of the eye is less obvious and was for a long time overlooked. In recent years much attention has been given to the matter with very good results.

The olfactory nerve, which is the exclusive organ of the sense of smell, distributes its terminals over the upper third of the nasal septum and also over the superior and middle turbinals, the area occupied by these filaments showing some variation in different individuals without any corresponding variations in acuteness of smell which, in fact, depends more on other things than upon the number of afferent nervuli, so long as there is a fair supply in normal condition. What is the minimum amount of olfactory nerve substance compatible with preservation of the sense has not been determined.

Many of the lower animals have more acute smell than man, some of these having also a relatively greater area devoted to the ramification of olfactory nerves. These facts have inspired a great deal of fanciful writing, fine-spun theories regarding transmission of traits, vestiges, survivals, rudimentary organs and ativism. For all this there is little scientific foundation. The quick-scented animals cannot be formed into a group to hold a place in any ascending or descending biologic scale, whether the scale depends upon structural characteristics or upon degrees of intelligence. Even within the same genus the differences are very wide.

The olfactory power of the bloodhound is extraordinary and is the dog's sole reliance in pursuing its prey; this power is slight in the grayhound, which chases by sight, not scent, a fact indicated by its original name, "gaze hound." A South African Bushman can smell a lion at the distance of a mile, provided there is a breeze and the beast is to the windward of the hunter. A white man would not recognize the leonine odor. This fact is often set forth as a proof that civilized man is, by evolution, losing the sense of smell; but tea-testing experts, whose discrimination depends chiefly upon olfaction in distinguishing a score of flavors, exhibit a keenness of smell more astonishing than that of the Bushman, and in their case heredity very seldom plays any part at all.

These phenomena have elicited another explanation: that differences in olfaction in animals, but especially in man, depend upon education. This suggestion has encountered objection, even ridicule, because there is no way by which the nerves may be multiplied nor their functionating power agumented; what can training do?

The objectors do not comprehend the proposition. It is true the nerve impulses cannot be modified by training. The sensations are not modified. The man who has learned to test teas has the same sensations today, when he can discriminate among a score of flavors, as he had when as a tyro he could not distinguish more than three or four. The result of education is wholly psychic: the change is not in his sensations, but in the use he makes of the sensations. Since this matter applies to all the special senses, which we shall consider, it is advantageously explained here.

External objects impress upon the nerve terminals sensations; the nerves transmit these to the brain and from them the brain forms its concept, or idea, of the external object. If the object is novel, many sensations may be necessary to form a complete concept; but if it be familiar, a few sensations furnish a part of the concept and the rest is supplied

by the recollection the brain retains of former concepts, which are suggested by the few sensations now experienced. A good illustration is furnished by the diverse effects of two languages. Let some one read to you an English passage containing a thousand words and occupy ten minutes in the reading. You find the rate of utterance deliberate and get a clear idea of every word. Let this be followed by reading in ten minutes this same passage translated into a language with which you are only partially acquainted. It will seem to you that the reader is proceeding at a rapid rate, that he is slurring many words and dropping out many syllables; you cannot grasp the signification and ask him to go slower, yet the clock proves that his utterance in both instances was at the same rate.

The fact is that the reader has omitted a great many sounds in both cases; only a part of the words have been phonated. You cannot understand the foreign language without the missing words, but you are so familiar with the mother tongue that your mind supplies what is lacking, because that is indicated by what is actually heard—a complete concept is made up from a few sensations, memory and association filling in the omissions. The process is so rapid and so sure that you are unconscious that many sounds have been suppressed.

In this respect, the action of the other special senses is just like this action of the hearing. They give us a few sensations, the brain fills out what is lacking and we have a complete idea of the external object, provided that external object is familiar. Suppose the South African Bushman instanced above is accompanied by a recently arrived European hunter. The breeze carries to them a peculiar odor, faint and momentary, which imparts to each the same olfactory sensation. To the white man it is a new thing and devoid of meaning. It is so slight that it barely produces a momentary impression scarcely exciting his notice; if he does notice it, he thinks it one more among the novel vegetable and animal smells borne by the wind across the veldt. To the Bushman it is intensely

significant; he halts, with every faculty alert, waiting for a repetition of the sensation; in a minute or two it comes, a mere whiff, but its quality is the same; motionless and silent, he awaits another repetition; the wind brings the third sensation and the hunter is sure. It is the odor which has been a subject of his thought since boyhood; on recognizing it his success as a lion stalker, even the safety of his life, has depended for years. It is one of his important items of knowledge, and those three evanescent sensations give rise to a vivid concept of the king of beasts and suggest a whole train of memories. He tells his companion, with absolute confidence, that he scents a lion lurking in the area of bushes visible a mile to the windward. When the beast has been found and slain, the European's incredulity changes to astonished admiration and upon his return home, he may publish an elaborate hypothesis, explaining how the Bushman came to possess extraordinary olfactory powers with a wide area of nerve distribution, the survival of a remote geologic age, and the baseless fancy may be considered scientific.

Although the sense of smell ranks far below sight and hearing, it is an important function and its conservation means much to the organism. The early pharmacists depended largely upon it in determining the quality of crude drugs and, although pharmaceutical assaying now yields more accurate results, olfaction is by no means useless in the laboratory. The garlic-like smell of hydrogen arsenide has given warning that this gas was poisoning the air, and the peachy odor of the deadly hydrocyanic acid has told of its presence in the very nick of time. Before the introduction of instruments of precision, diagnosis was much assisted by the sense of smell, as is attested by medical text books published before the middle of the last century. The present-day city physician, who by some means is temporarily deprived of his accustomed aids, is at a great disadvantage in comparison with the "back-woods doctor," who relies wholly upon his own natural powers.

Though in some ways substitutes may take the place of

olfaction, they can in no respect perform its function as a pleasure-giving sense. Anosmia abolishes a group of physical gratifications which science is powerless to restore. The pleasures of eating and drinking, aside from the mere allaying of hunger and thirst, depend mainly upon olfaction. The gustatory nerves can recognize the sweet, the sour, the bitter, the pungent and the saline, but very little more. The multiform modifications of these primary tastes depend upon flavors recognized by the olfactory nerves. The rich savor of roasted meat and the delicate bouquet of wines are made known by minute particles borne upon the air and impinging upon the nerve terminals distributed over the septum and turbinals. If both the anterior and posterior nares are occluded, the best grilled venison is hardly distinguishable from corned beef and the finest dry champagne differs little from water charged with carbonic acid. It has been proved that when mastication and insalivation are accompanied by pleasurable sensations, the stomachic digestion is better than when pabulum is simply put into the mouth, like coal shoveled into a furnace, without any consciousness as to its quality. This is true whether the unconsciousness is due to such preoccupation of mind as prevents the eater from knowing what he is eating, or owing to abolition of the sense of smell, rendering normal gratification impossible. It is very probable that in this way anosmia becomes an influential, though unnoted, factor in the injury of digestion and the impairment of nutrition.

Though in rhinological practice the nasal septum and turbinals are subjected to many operations, serious injury to olfaction is a rare consequence. Responsibility for damage to the function, or its abolition, rests nearly always upon syphilis, or upon atrophic rhinitis, either of these diseases being liable to destroy the nerve terminals distributed through the mucosa. It is therefore very important to safeguard this membrane, and if this can be done the function will incur but little danger for the nerve trunks usually resist the morbid process. Even if a large number of the terminals have been sacrificed, it is

highly important to save the balance for the sense will be retained if the olfactory filaments upon one side of the nose or even a portion of them are preserved and, in view of the way in which the special senses act and of the psychic training which can make much of even a few sensations, it is a great boon to a patient to be saved even a modicum of the neural apparatus.

The interdependence of diseases of the nose and those of the eye is a pathological truth, whose importance was not fully appreciated until a recent date, but when once brought before the profession it was accepted without controversy. That it met with so little dissent was due to the fact, promptly recognized, that such interdependence was rendered inherently probable by the anatomical relations of the two organs. The nasal cavities are separated from the orbit by a very thin wall of bone, which is pervious to heat, electricity and to the recently discovered forms of radiation (also partially to light, as proved by the phenomena of transillumination). Moreover the blood vessels, lymphatics and nerves of the two regions are intimately associated, for they are in close proximity and the branches supplying the two organs often come from a common trunk. In addition, the nasal duct passing through the lachrymal canal furnishes a connecting pathway lined by a mucous membrane continuous with that of the nares and of the orbit, an open road between them, one that is often traversed by invading microbes. It is obvious that morbid conditions affecting one region may readily extend to the other and that this extension may occur in either direction. It seems, however, that transmission of disease from the nose to the eye is much more common than its converse.

The nasal causation of ophthalmic lesions is (1) mechanical, (2) infectious, or (3) reflex. To determine the etiological relation is rationally the first step and, in all eye diseases, which may possibly have a nasal origin, the fossæ and sinuses should be examined and any morbid conditions there found should be subjected to proper treatment. Such a course is justified by the record of numerous cases, in which removal of the nasal

lesion has resulted in complete cure of the ophthalmic disease, which previously had seemed intractable. A further reason for such examination is the fact that the patient, while suffering much from the ocular malady, may be quite unconscious that there is anything wrong in the nose; the underlying morbid state may have existed for a long time, causing few symptoms and hence have been entirely overlooked.

The occlusion of the nasal duct with the consequent overflow of tears and maceration of the lower eyelid and the subjoined skin of the cheek is frequently due to obstruction at its lower orifice where it empties into the inferior nasal meatus. If the stenosis has persisted for any length of time, strictures in different parts of the duct complicate the difficulty and very often there is suppuration. An accepted operation is that which elevates and rolls back the mucous membrane lining the nasal wall, removes the bone from the anterior side of the lachrymal canal, slits up the duct to the sac, cleanses it of all morbid products, and then replaces the mucous membrane, creating a new duct of larger lumen. Another operation is that devised by Yankauer and previously described. Intranasal hypertrophies may cause œdema of the eyelids by pressure upon the blood vessels and the obvious treatment is the surgical reduction of the hypertrophy.

Infections of the nasal passages and especially of the accessary sinuses may traverse the mucosa lining the lachrymal canal and attack the orbital tissues, causing suppuration and sometimes even abscess of the orbit. In such cases the detergent and antiseptic treatment must be applied in both regions. Conjunctivitis is often due to the extension of a preëxisting rhinitis. When so produced, it improves under treatment but shows a marked tendency to relapses so long as the nasal inflammation continues. If this is cured, the eye generally makes a good and permanent recovery.

Among reflex disturbances are contractions of the extraocular muscles, causing squinting; diplopia and various forms of asthenopia. There are also instances where grave ophthalmic

maladies, such as glaucoma, have a rhinologic origin. Just how they are produced is not known, but their nasal etiology is proved by the fact that when the nose is restored to a normal condition, the eye disease makes no further advance and sometimes complete recovery takes place.

The judicious course in all these morbid states is to search carefully for any nasal abnormalities and endeavor to correct such as may exist. It will often be found that the restoration of health to one organ leads to recovery in the other, and even if this favorable result is not reached the patient is better off, as far as his nose is concerned, while the optic condition is no worse than before.

CHAPTER XII

EPISTAXIS

Epistaxis is a symptom rather than a disease. The word by derivation and original usage signified the slow escape of blood from the nostrils, drop by drop, but as employed at present it includes all forms of bleeding from the intranasal tissues, whether very slight or dangerously profuse.

Its predisposing causes are constitutional and local. Among the most important of the first class are hæmophilia, scurvy, purpura, and some of the infectious fevers, notably typhoid; in addition stands anything which raises the blood pressure, either positively or relatively. Nephritis and arteriosclerosis directly increase the tension upon the vessel walls and hence the liability to extravasation, while the same result follows a decrease in the counterbalancing pressure exterior to the body, which makes the tension relatively, though not positively, greater. Those crossing very high mountains, such as the Andes, where the air is rarefied, and those ascending to great altitudes in balloons have attacks of epistaxis, which in such instances is a natural prophylactic preventing apoplexy and visceral engorgement. Upon return to usual atmospheric conditions the attacks cease. The bleeding, which is called vicarious menstruation, may also be protective in its effects; it is doubtful whether the process is really vicarious, as this and similar phenomena may be the result of a general plan of compensation affecting all the organic functions and regulated by the ductless glands. When constitutional predisposition is strong, a very slight excitant is sufficient to cause hæmorrhage; there is probably always an exciting cause, but it may seem so trivial as to be overlooked. This often occurs with the symptomatic epistaxis ushering in the first stage of typhoid fever.

Predisposing causes of a local nature are nasal neoplasms, especially those of malignant character, like sarcoma, which bleeds very readily, and some of the intranasal hypertrophies accompanied by congestion. Rhinitis is not, *per se*, prone to produce epistaxis.

The exciting causes are local and chief among them stands traumatism of many kinds, as we would naturally expect from the fact that the nose is so placed as to encounter many injuries. First, in point of frequency if not gravity, are hurts inflicted by the human fist, as in the prize ring and the fights among boys. The association of epistaxis with such blows is immemorial and hurts received in this way are commonly regarded lightly; but the immediate results are sometimes serious and, in a large percentage of cases, the intranasal diseases of adult life are etiologically connected with these incidents of adolescence. The impact of such blows upon the outside of the nose may cause only a slight contusion, but the transmitted force ruptures intranasal blood vessels, usually those of the septum. Another exciting cause is picking at the mucosa with the finger nails, hairpins, glove buttoners and other seemingly harmless, but really injurious implements; so also is violent blowing of the nose. Rhinological operations necessarily cause some bleeding but can scarcely be classed among morbific causes as they are therapeutic measures. Precautions and correctives associated with surgical procedures are considered together with the operations. Foreign bodies in the nose, commonly small articles like buttons and cherry-stones inserted by eccentric children, who afterward conceal the act, are both predisposing and exciting causes, and when the origin of a hæmorrhage is obscure, search should be made for them.

The diagnosis of epistaxis is so obvious that spontaneous hæmorrhage from another organ could scarcely be attributed to the nose but the converse is not so certain. If much blood has passed downward from the posterior nares, it may be expelled by coughing or vomiting giving rise to the impression that there is a lesion of the lungs or of the stomach. The differentiation

really belongs to the diagnosis of hæmoptysis and hæmatemesis; but it may be noted here that, if, when the patient is sitting up with the head inclined forward, blood exudes from the nasal vestibule, its source cannot be gastric or pulmonary; it must come from some place above the plane of the pharynx. A very important point as to the origin of the blood is the question whether it comes in part from the supernasal region, indicating a fracture at the base of the skull. In traumatic cases, when hæmostasis has taken place upon the surface of the septum and contiguous parts, and nevertheless blood continues to descend the nostrils, the existence of a fracture in the sphenoidal region becomes a matter for grave consideration.

The treatment of epistaxis is practically restricted to cases of severity; slight bleeding, which in a short time stops spontaneously, is seldom brought to the attention of the rhinologist. From this fact there are two logical deductions. The urgent feature in epistaxis as we see it is not the abnormality of some vessel or some morbid process, but the depletion of the body's supply of blood and how much yet remains above the minimum limit; moreover the supreme object of treatment is to stop the loss of blood. This being our paramount duty, we can ignore all the remedies recommended for their constitutional effect. Many such are mentioned in books and they have utility in treating the systemic conditions which act as predisposing causes; but I know of none that have any value in checking the bleeding. They are useless in the emergency of the moment and that is what we must meet. When the patient is out of danger there will be time to consider constitutional dyscrasias and their proper treatment.

As the therapeusis is wholly local, it is most important to find the bleeding spot. This may be anywhere in the intranasal region, but nine times out of ten it is upon the surface of the cartilaginous part of the septum, which is rendered extremely vascular by a close network of submucous vessels. To discover the site of the outflow the nostrils must be cleansed; the clots and all other contents should be washed out with water

at a temperature of 110° F. This advice is contrary to the teaching of many, who say that clots should not be disturbed, as they are a starting point for a coagulation, which will eventually stop the hæmorrhage. Instead of this, the bleeding goes on behind the clots, valuable time is lost and the patient imperiled. As soon as the obstructions are out of the way, cotton pledgets steeped in a solution of cocaine hydrochlorate, eight per cent. and solution of epinephrin chloride, one-tenth of one per cent. should be inserted on the affected side and kept in place, till their anæsthetic and ishæmic effect is fully produced. They temporarily lessen the hæmorrhage and give a chance to use the nasal speculum, which should be at once introduced and the bleeding point located, if possible. Here much depends upon the promptness and skill of the surgeon for the ischæmia is of short duration. If the rupture is found upon the cartilaginous septum, accessibility renders the subsequent procedures much easier. Hæmostasis can be produced by a solution of silver nitrate (℥j:fl. ℥j) by chromic acid, by trichloracetic acid, or by the electrocautery, the choice of a styptic depending on the location of the spot and also upon the facilities available in circumstances requiring speedy action.

If the bleeding point cannot be found or if there is diffused oozing over a large surface treatment with gelatin may be employed. This substance liquefied by heat and sterilized is injected in sufficient quantity to fill the nasal cavities; upon cooling it solidifies and forms a sort of tampon which fits into all recesses and sinuosities.

Packing with fibrous material, such as sterile gauze, is an old expedient, which holds its place among remedies of last resort, though it is open to serious objection, because it wholly stops drainage, leaving any septic discharges or any decomposing liquids incarcerated in close proximity to the ear and the brain, whose infection may lead to otitis, or meningitis. Still the condition of imminent danger, in which packing is resorted to, fully justifies its use and, if the tampons are

not allowed to remain more than twenty-four hours, they seldom do serious harm. Procrastination in their removal has caused most of the bad results. The danger is much greater if both the anterior and posterior orifices are plugged than if the latter remains open.

Anterior packing is effected with a long strip of sterile gauze, one end of which is carried to the upper boundary of the intranasal space upon a blunt probe and the rest is added in short folds until the cavity is filled. The balance of the strip is then cut off after leaving an inch or so protruding from the vestibule; this can be attached to the outer surface of one of the alæ nasi by a scrap of adhesive plaster. In twenty-four hours, or as much sooner as conditions permit, the gauze is removed by gentle traction upon the projecting end, its gradual withdrawal, in this way, causing no disturbance of the coagulation, which has taken place. When posterior plugging is demanded, the intranasal cavity must be cleansed and a soft catheter passed through the lower meatus from the vestibule to the naso-pharynx. This catheter has been threaded with a piece of stout silk ligature, eighteen inches long and doubled at the middle, so that the loop comes through the eyelet and is fastened by turning over the point. When the end of the catheter appears in the pharynx it is seized with forceps and drawn into the mouth, the loop is disengaged and traction made upon one strand of the silk till its free end appears, when this end is brought outside of the lips. The catheter is then gently drawn outward until freed from the other silk strand. At this stage of the procedure we have a cord entering the vestibule, extending to the naso-pharynx, there turning in an anterior direction and coming out through the mouth, there being a surplus in length at both ends. Gauze is now folded into a sheaf-like tampon, large enough to close the posterior outlet, and the middle segment of the cord is firmly bound around this tampon and securely knotted. The surgeon now, with his left hand, makes traction upon the nasal end of the cord, gradually drawing the

tampon backward into the pharynx and then upward to its place at the postnasal orifice, while with the forefinger of his right hand, he guides the sheaf past the soft palate and into the exact position it should occupy. Cotton or gauze is then introduced through the vestibule, to fill up the intranasal space, and finally the two ends of the silk cord are tied together, making the whole secure.

This method of posterior packing is largely used and is recommended by the facility with which the tampon can

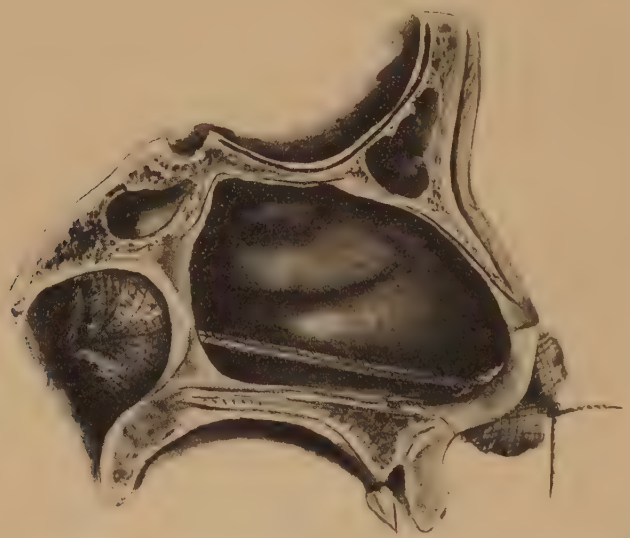


FIG. 65.—Epistaxis; tampons applied to the anterior and posterior nares.

be withdrawn from the naso-pharynx, even by one having little practical familiarity with the anatomy of the region; for the saturated plug of gauze can always be dislodged by a downward pull upon the cord, emerging from the fauces, and then readily drawn out through the mouth. On the other hand, there is a serious objection in the fact that, in some patients, the cord traversing the oral cavity causes nervous irritation, provoking cough, sneezing, nausea and other symptoms quite harmful under the circumstances which require rest

and quiet. On this account, a modification has been devised which dispenses with the cord passing through the mouth (Fig. 65). The technique of this procedure is just the same up to the point when the end of the catheter is seized and drawn outward. At this stage, instead of pulling one strand entirely into the mouth, the loop is drawn outward, free of the lips, and fastened around the middle of the gauze tampon, which is guided into place by the right forefinger as before described. After the tampon is attached to the doubled cord, the catheter is withdrawn and the left hand makes the traction along the nasal floor, as in the other method, except that this traction employs the two cords, instead of only one. After the posterior tampon is properly placed and the anterior packing has been done, the two cords are tied at the vestibule and then wrapped around a small sheaf of gauze and knotted. This retainer, resting against the margins of the nostril, keeps the cords extended along the nasal floor without undue strain. To reopen the posterior orifice, the surgeon cuts the cords at the vestibule allowing them to slip backward and dislodges the tampon with his finger, or naso-pharyngeal forceps. This requires more skill than the simple traction of the other method but presents little difficulty to an operator of experience and dexterity.

CHAPTER XIII

THE NASO-PHARYNX

When the breath-road emerges from the nares, it joins the food-road, passing backward from the lips, and for a distance of about four inches the two roads coincide, to again separate upon their downward course, the breath-road taking the anterior position and entering the trachea, through the larynx, and the food-road crossing to the rear and entering the œsophagus (see schema in Chapter I). The region in which the two roads are coterminous is called the pharyngeal space, the pharynx, or the throat. It is an irregularly shaped, hollow cylinder, decreasing in size from above downward and somewhat flattened from the front to the back. Its inclosing wall comprises three layers, the outer muscular, the middle fibrous and the inner composed of mucous membrane, which for the upper third of its extent is covered by a ciliated epithelium and below that by one of squamous type. This threefold wall derives osseous support posteriorly from the cervical vertebræ of the spinal column; in front it is strengthened and its contour preserved by attachments to the superior maxillary, inferior maxillary, sphenoid and hyoid bones.

Five locative prefixes are used to describe parts of the pharyngeal space; the naso-pharynx is at the top, adjacent to the nares, and is also called the pharyngeal vault; the meso-pharynx, immediately below this, is the central portion; the part joining the oral cavity is termed the oro-pharynx, and that directly opposite, along the posterior wall, the retro-pharynx; the lower extremity, at the orifices of the larynx and œsophagus, is named the laryngo-pharynx. These five terms do not signify separate areas with precise boundaries, but are employed, with some latitude of meaning, to describe regions in the open space

inclosed by the pharyngeal walls, thus proving very convenient in discussing the surgical procedures within this territory. A similar elasticity of meaning applies to the statement that throughout the pharynx the breath-road and the food-road coincide. Every part of the space is reached by the air, both inspired and expired, but in the usual upright posture, morsels of masticated food pass backward and downward, without touching anything above the meso-pharynx; nevertheless, the whole cylinder is accessible to them and by a change in posture, or by muscular spasm, they are readily thrown into the naso-pharynx so that it is properly included in the thoroughfare occupied jointly by the breath-road and food-road.

The naso-pharynx, constituting the upper portion of the throat cavity, though continuous with the space below it and very similar in appearance, has, nevertheless, certain anatomical and physiological features, which give it a distinct character, exerting an influence upon morbid processes occurring in this region, so that they exhibit peculiarities not elsewhere observed. Among these distinctive features are the four orifices, the two nares opening upon the anterior aspect and the right and left Eustachian tubes upon the sides. These communications bring the naso-pharynx into very intimate association with the nose and the ears so that there is much interdependence in both health and disease. In addition, its mucous membrane has a ciliated epithelium, like that of the nasal fossæ, and it coöperates in sterilizing the air entering by the breath-road. This kind of epithelium extends but little beyond the plane of the hard palate, the lower boundary of the naso-pharynx, the rest of the throat having the squamous variety. Here, also, the mucosa is supplied with numerous glands secreting mucus and, at the rear of the vault, these glands are of the racemose type and exist in such abundance as to form a thick layer embedded in the submucosa, an important fact in connection with the etiology of adenoid growths. As a consequence of these structural features some morbid conditions are so modified in the naso-pharynx that it is most convenient to consider

them as diseases proper to this region, while others produce here the same manifestations as elsewhere and are best viewed as affecting a wide field, of which this is one part.

Under the second head comes simple, acute, catarrhal pharyngitis, a disorder whose manifestations are nearly identical in all parts of the throat. Causation, symptomatology and treatment may be considered as those of a single disease, whose variations are those of locality not of character. It will be subsequently discussed from this point of view. With the chronic form the case is different; here so much modification results from the peculiarities of the naso-pharynx that we have to deal with what is virtually a distinct malady; hence it is clearer and more logical to take up this disease by itself, designating it by a distinctive name, significant of both its character and locality; chronic naso-pharyngitis.

CHAPTER XIV

CHRONIC NASO-PHARYNGITIS

Chronic naso-pharyngitis, called also postnasal catarrh, is a common affection which often begins insidiously and exists for a long time before being subjected to special treatment. It is usually a sequel of some abnormal condition in the nose, though the sudden and marked changes in temperature, characteristic of our climate, may also be a factor in the etiology. This is a very common opinion among the laity.[1]

The symptoms, in addition to a variable amount of discomfort in the throat, are mainly due to the secretion of a liquid produced by the sub-acute inflammation; a mixture in changing proportions of serum, mucus and pus. At night this accumulates in the naso-pharynx and in the morning its irritating effect prompts the patient to eject it. This he often finds difficult. The mixture is tenacious and adheres to the surface of the mucosa. It frequently gives to the patient the sensation that a foreign body is lodged at the junction of the nose and the throat. He makes violent efforts to dislodge the obstruction by swallowing, by forcible blowing of the nose, by persistent hawking and spitting. The natural result is nausea and sometimes even vomiting. After many repetitions of such experiences some patients learn to dislodge the adherent mass by introducing a finger into the postnasal space. This, of course,

[1] This disease is one of a group of throat affections, for which the American climate is popularly held responsible. Young students, who expect to make singing their profession, are advised to live in southern Europe through their years at the music schools, so as to protect their voices from injury during the formative period. There are, however, some excellent vocalists, who never went abroad until maturity, but followed careful habits of healthful living. To accept the usual advice may prove profitable to vocal students—the plan is certainly profitable to the foreign teachers.

tends to sicken the stomach. During the day there is a disagreeable sensation that a liquid is falling, drop by drop, into the back part of the throat and this feeling pretty truly represents what is taking place.

The frequent and irrepressible impulse to clear the throat soon becomes very annoying to the patient and he feels painfully that he is growing repulsive to those around him. In time, the continual overaction of the pharyngeal muscles leads to much relaxation and to congestion of the velum palati; the tip of the elongated uvula tickles the fauces and thus serves to aggravate the trouble.

The general health is apt to suffer in consequence of indigestion and disordered metabolism caused by the swallowing of muco-pus, a surprising quantity of which forms in the course of the day. The Eustachian tube and consequently the middle ear are often involved. Frequently the voice is affected in a way that is trying and, with professional vocalists, endangers their business. A singer, subjected to repeated interruptions by the necessity of clearing his throat, comes to lose confidence in his voice, dreading that it will fail him during a public performance, and the nervousness of fear impairs his control of the vocal organs. In addition to this, the swelling incident to the disease encroaches upon the space of the epipharyngeal vault, decreasing the resonance of the tones produced. This inferior quality shows itself particularly in the singing voice, simulating the effect of age, the calamity whose slightest sign alarms the public singer. For him, obviously the disease under consideration is a most serious matter.

The morbid anatomy of chronic naso-pharyngitis includes an increase in the lymphatic and other glandular elements and also in the connective tissue together with a thickening of the mucous membrane and continuous engorgement of its capillaries with venous blood. The surface when inspected with the post-nasal mirror appears very red, congested, and in parts covered with thick, tenacious muco-pus. These appearances, together with the symptoms already described and the clinical history

of the case are sufficient for a correct diagnosis. The patient, particularly if he makes professional use of his voice, is naturally very solicitous regarding the prognosis, not only as it concerns his health, but in regard to the conservation of his vocal powers. Assurance may be given that the prospect of complete recovery is good, provided the patient's habits are carefully regulated and provided the treatment is skilful and long continued.

The therapeutic measures are both constitutional and local. Normal nutrition is to be promoted by a plain, nutritious diet, without luxuries, and elimination encouraged by exercise out of doors, and by baths, whose frequency and temperature are adapted to individual needs. There is a great diversity in this respect and the kind of baths which are beneficial can be determined only by trial. Constipation must not be permitted; the regulation of the bowels will depend mainly upon proper food; but inaction for more than twenty-four hours calls for prompt administration of a mercurial, or one of the salines. The under garments must be such as will absorb the cutaneous secretions and the patient's habitation, especially his bedroom, must be well ventilated. Alcohol and tobacco are interdicted. As to hours and methods of work, it is utterly futile to lay down any rigid directions. Excepting the leisure class, which in our country is very small, our patients, unless bedfast, are engaged in their various vocations and must conform their habits to the requirements of those callings. All that can be done by the patient, all that he should be asked to do, is to make the strain of his work as moderate as he can and to avoid unhealthful practices which are not a necessary part of his occupation. If any constitutional dyscrasia or diathesis exists, it should have appropriate treatment.

The first in order of the local procedures is the correction of any abnormal conditions which may exist in the nose or tonsils, for these are often the cause of the nasopharyngitis and when they are rectified it tends to a gradual, spontaneous cure. The next step is to thoroughly cleanse the field of morbid action. To secure room, shrink the middle and lower turbinals

with cocaine and epinephrin solution, then through the anterior nares direct a spray upon the naso-pharynx so as to irrigate it in every part and to loosen, as much as possible, the adherent secretions. For this purpose employ Dobell's solution (Chapter III) or a similar alkaline lotion. Then introduce through the anterior nares a cotton-tipped applicator and wipe out the naso-pharynx, dislodging all the tenacious mucopus found upon the walls and carrying it away. Some patients, who are used to manipulations with their throats, acquire good control of their muscles and bear quietly what would in others excite violent gagging and coughing. In such tolerant throats, it is a good plan to introduce the applicator through the mouth, entering the vault from below. When inspection with the postnasal mirror shows that the walls of the naso-pharynx are thoroughly clean, they should be medicated with glycerine and tannic acid (four per cent. solution) the applicator passing through either the nares or the mouth. Following this, the spray of camphor and menthol (five grains of each in a fluid-ounce of liquid petrolatum) introduced by the nasal route should be used for three or four days.

By this time, sufficient progress has usually been made to employ the iodine preparations. Of these Boulton's solution (Acid carbolic, cryst. gr. xviij; Tr. iodini comp. fl. ℥j; Glycerini fl. ℥jss; Aquæ dest. fl. ℥ij. M.) which is the mildest, should be used first. In a couple of days it may be succeeded by formula No. 1, iodine, given in Chapter VII. This should be applied upon alternate days, until its effects are pronounced, its use being preceded, each time, by a thorough cleaning of both nose and pharynx. A two per cent. aqueous solution of alum, sprayed upon the fauces after each of these treatments, will do much to correct the congestion and relaxation of the velum palati, which are commonly present. Under these measures we may expect a gradual cessation of the morbid or excessive secretions, a return of the capillaries to their normal size, and catabasis of the adventitious cells whose presence has caused tumefaction of the walls and interference with the resonance

of the voice. There may, however, occur at any time attacks of acute inflammation which will require intermission in the use of iodine and a return to sedative treatment, till they are subdued. In some hypersensitive cases, particularly when there is relaxation or ulceration of the mucous membrane, it is advisable to replace the iodine with a two per cent. solution of silver nitrate. In using either of these remedies with the applicator, care must be observed that the cotton tip is only moist, not dripping, as a drop falling into the larynx is liable to cause violent spasm and alarming dyspnœa.

The plan of treatment above described has been found, in the writer's experience, best adapted to the cure of this disease, but neither it, nor any other, should be followed in a routine fashion. Every time the patient presents himself, the breath-road should be carefully examined and, if conditions have changed, the treatment should be altered accordingly. It is only thus that we may hope to bring about a restoration of the structures which have deviated so far from the normal standard.

The naso-pharynx is sometimes affected by inflammation of an atrophic type whose symptoms resemble those described above. There is also similarity of appearance, but careful examination shows that the crusts are larger, dryer and of darker color. Their removal discloses a membrane which is dry, pale and glistening, not red and congested, as in the hypertrophic type. Upon this uncovered membrane are frequently found shallow ulcers of traumatic origin, due to the patient's efforts to remove the crusts with his fingers. The pathological process consists in the exudation of muco-pus of a peculiarly tenacious kind which rapidly dries into hard crusts; beneath these takes place a structural change, the epithelial and glandular elements undergoing degeneration and finally disappearing, to be replaced by connective tissue of low vitality. The disease may be an extension of preëxisting atrophic rhinitis or may be caused by long continuance of the hypertrophic variety. It may also arise in the course of anæmia, tuberculosis, or syphilis. Under judicious treatment the prognosis is good,

as to checking further extension of the disorder, but the regeneration of the atrophied membranes is not to be expected.

As to treatment, the presence of tuberculosis, syphilis, or other general disease, is an indication to administer the proper constitutional remedies. Topically, Dobell's or another alkaline solution, should be used to thoroughly cleanse the naso-pharynx, through either the mouth or nose. All crusts should be removed by a cotton-tipped applicator wet with an alkaline liquid. Ulcers are touched with a two per cent. silver nitrate solution and then the vault insufflated with powdered thymol-iodide. After the ulcers have healed, the stimulating and catabasic treatment is continued with the compounds of iodine and iodide of potassium. Three formulæ are given in Chapter VII. As home treatment, the patient is instructed to irrigate the naso-pharynx several times daily with a solution which is both alkaline and alterative; one of the best combinations being a pint of normal salt solution with the addition of fifteen drops of the tincture of iodine. This is not at all strong and, after it has been used a short time with good effect, it may be strengthened, little by little, until finally thirty drops of the tincture are added to the pint of salt water.

CHAPTER XV

ADENOIDS

Adenoids are enlargements of the lymphoid tissue which always exists upon the upper, posterior wall of the naso-pharynx. To this growth has been applied the name, Luschka's tonsil, because it was first fully described by that anatomist, and also the term, pharyngeal tonsil, in contradistinction from the single lingual tonsil and the pair of faucial tonsils. This growth varies from a slight coniform elevation above the mucous membrane to a large and usually segmented mass, entirely obstructing the postnasal orifices and thus completely occluding the breath-road.

Most cases occur between the third year and puberty, but the condition has been observed in the first year of infancy and even at birth. At puberty, adenoids tend to decrease spontaneously and even disappear, because at this period the bones of the face develop rapidly causing a great increase in the size of the breath-road, and also because of the tendency manifested at this time for all lymphoid tissues to undergo a retrograde change with shrinkage and partial atrophy. The natural tendency toward the development of adenoids during the periods of childhood and youth is supplemented by the influence of infections and hence these growths are often observed subsequent to attacks of measles, scarlatina, diphtheria, and rötheln. They are also prone to take place in those affected with tuberculosis and syphilis and are very common in bottle-fed children and among the neglected and poorly nourished.

Symptoms of the earliest stage are apt to be overlooked or, if observed, misinterpreted. When the child is brought to the physician, it is usually on account of marked mouth breathing; loud snoring during sleep; incipient deafness; or such mental

dulness as causes him to fail in his examinations at school. By this time the disease is fully developed. Its pathology is comparatively simple: the characteristic feature is the overgrowth of a group of lymphoid cells, held together by a network of connective tissue, through which capillaries, more or less tortuous, extend their ramifications. Interspersed among these cells are a number of mucous glands and there is intermittent exudation of serum and mucus, which drops down into the œsophagus. The lymphoid mass, if it attain any considerable size, assumes a plicated or racemose form, hanging downward and forward across the entrance to the nares, which may be slightly obstructed, or entirely closed. A hypertrophic body of this sort would not, in some situations, give much trouble, but located at the curve of the breath-road, it produces a symptom-complex of wide extent and great importance. The condition of sub-acute inflammation existing in the naso-pharynx extends to contiguous structures, causing rhinitis and increasing the adolescent liability to epistaxis, or following an upward course affects the mucosa of the Eustachian tubes and subsequently that of the middle ear. Otitis media may also result simply from the pressure of the growth against the Eustachian orifice, whose closure stops the aural ventilation and drainage. Either sequence may damage the hearing. If the invasion of contiguous structures takes an anterior direction, the faucial tonsils and the uvula will be affected. Concomitant with the involvement of the faucial tonsils, appears a granular pharyngitis, produced by the same process of extension. The mucosa becomes red and congested, while frequently long strands of purulent mucus are seen hanging from the naso-pharynx along the posterior wall. Gastric digestion may suffer from muco-sero-pus which finds its way into the stomach and mingles with the peptic secretions. The indigestion is made worse by the practice of rapid eating to which the child is almost forced, because the occupation of the food-road, while mastication and swallowing go on, stops his respiration and he satifies his hunger by bolting the food as fast as possible, so as to resume breath-

ing. Of course, this remark applies to cases in which the normal breath-road has been occluded and the only way to the lungs is through the mouth.

Mouth breathing is a characteristic sign of large adenoids; when long continued it produces a peculiar physiognomy which is typical, and nearly sufficient for diagnosis without other signs. It is also followed by many anatomical changes whose occurrence is made possible by the youth of the patients, their structures, including the bones, being in the stage of development and subject to alterations which would be impossible at a later period of life. The disuse of the nostrils for their natural function of breathing prevents their normal development and they have a pinched, narrow look; this makes the bridge of the nose appear wider than it really is. Faulty growth of the superior maxillary bone produces a common anomaly, a high, narrow vault of the hard palate, termed from its shape, "the Gothic arch," and, for the same reason, the upper incisor teeth project forward, so that they are not fully covered by the upper lip. Habitual lack of an adequate supply of air stunts the development of many structures. There is lack of muscular strength and of nervous energy; the unexpanded chest is flat and the shoulders have a forward stoop which in children partly deaf is emphasized by leaning toward a speaker, in the effort to hear. The general lowering of vitality, consequent upon the imperfect oxygenizing of the blood, makes the patient peculiarly susceptible to tonsillitis, diphtheria, laryngitis, bronchitis and the protean forms of tuberculosis. Cervical adenitis is common, both on account of the impaired power of resistance and the ready absorption of diseased products of the adenoids, through the lymphatics. Insomnia, night terrors, enuresis and some forms of chorea have been shown to be sequels of neglected adenoids, even epilepsy has been placed in this category and, though one should be cautious in making assertions regarding the etiology of this grave disease, there is proof that in some cases epileptiform seizures, which had become chronic, have ceased after adenoidectomy. Both voice and

speech are frequently affected: the vocal resonance is lessened by the growth's encroachment upon the vault of the naso-pharynx and restriction of the normal movements of the velum palati interferes with the articulation of certain sounds, particularly the liquids m and n, which the patient changes to the corresponding mutes, b and d.

The psychic symptoms are of especial interest. Diminished nutrition of the brain, dulled hearing, disordered metabolism

FIG. 66.—Case of nasal obstruction from adenoids, showing characteristic, dull, facial expression.

and general asthenia combine to impair the mental power of those suffering from adenoids and, in the past, before their malady was understood, they were considered intellectually deficient: backward, stupid children, close to the border line of the mentally defective. These children have a dull, listless expression of face, the features sometimes taking on a mask-like immobility. Their speech is slow and imperfect in articu-

lation; their movements lack the sprightliness natural to childhood; the feet are raised but little in walking and often dragged; while in the worst cases there are signs of muscular incoördination. At school, they cannot keep up with their fellows and drop out of the classes, so that they remain year after year in the same grade.

FIG. 67.—The patient shown in Fig. 66, six months after removal of adenoids. The normal facial expression is entirely restored.

The illustrations here presented show a vivid contrast between the normal countenance and the dull, listless, facial expression produced by adenoids. Fig. 66 reproduces the photograph of a boy in whom the breath-road had been seriously obstructed by adenoids. Observe the open mouth, the pinched nostrils, the stolid, stupid expression of the face. Fig. 67 portrays the same lad, six months after removal of the adenoids. He has completely regained the normal appearance

of his face; the lips are closed and there is the harmony of features and vivacity of expression natural to an active, intelligent boy of his age.

These unfortunate children afflicted with adenoids were instrumental in bringing about a great and beneficent change in modern education, for the wonderful improvement in their mental condition, which followed the removal of the growths, powerfully influenced pedagogical thought and led many of the best teachers to accept as a basic principle, that the first thing in a course of education is to ascertain whether the pupil is physically and mentally normal; so that he can benefit by the instruction to be given. The state of his body must be learned by medical examination and if morbid conditions exist, they must, if possible, be corrected. At the start of any proper plan of teaching there must be conference between the teacher and the physician. As has been pithily said, "For the mouth-breathers, the keen curette did more in five minutes than the keen pedagogue in five years."[1]

The diagnosis of adenoids can usually be made by the symptoms alone, but it is desirable, in every case, to make a rhinoscopic examination, to dispel any possible doubt regarding the presence of the growth and also to ascertain its size, shape

[1] The cartoons in *Punch* (London) and other illustrated papers have depicted every type of physiognomy and, among the pictures of stolid schoolboys, "dunces, blockheads," are faces which might well be transferred to medical text books as portraits of mouth-breathers. Such unlucky boys were the butt of ridicule for their schoolmates, and older people often misjudged their stolidity and considered them disrespectful and stubborn. A lad of this sort fared badly in the oldtime school. He was given a task, told to "mind his book" and, when he failed to "commit his lesson," received condign punishment. The schoolmaster gave him a sound thrashing and then made him stand in a corner, with his face to the wall and his head crowned with a conical cap of white paper, bearing in large black letters the word, "Dunce." When the times grew more humane, flogging and dunce cap fell into disuse, and the backward boys were segregated in special schools. Here they were made the subject of various pedagogical experiments; monitor teaching; object teaching; Froebel's kindergartening; all sorts of things, except the right one; until at last medical science interfered and gave the boys what proved the panacea for their ills—the chance to breathe.

and other qualities. A few drops of a two per cent. solution of cocaine in the anterior nares will not infrequently so shrink the turbinals that, through a nasal speculum, we may see the adenoids as pale, glistening masses hanging from the vault of the naso-pharynx; when the patient swallows these masses rise and move forward into the nasal fossa; posterior choana. In many instances the adenoids can be seen reflected in the post-nasal mirror. If neither anterior nor posterior rhinoscopy gives a satisfactory view, we must resort to digital palpation. This is an unfailing diagnostic procedure, but it is unpleasant and it is advisable for the surgeon to give a prior explanation of just what he intends to do. The patient, with mouth well opened, sits upon a low-backed chair, the surgeon standing behind, uses one hand to press the cheek between the upper and lower teeth, a precaution against their biting the examining finger; then the index-finger of the other hand is introduced through the mouth, passing to one side of the uvula, and going up into the naso-pharynx. This cavity is thoroughly, but gently, explored and, if adenoids be present, the finger will be covered with blood, for the membrane enveloping the growth is thin, friable and bleeds very easily. Adenoids feel like a soft, gelatinous mass; the sensation imparted to the finger is peculiar and characteristic; when once experienced, it is afterward easily recognized, though unfortunately we have no distinctive word which describes it accurately. In this and many other instances, our nomenclature fails to furnish terms to adequately express our ideas.

When the diagnosis has been established by visual or digital examination, choice must be made among plans of treatment. There is seldom any doubt upon this point, for in the vast majority of cases, adenoidectomy is far better than anything else. In competent hands, this is a safe operation and the risk of recurrence is so slight that it may be disregarded. There is a partial exception in the case of very young children and their parents should be warned that an attack of some infectious disease, particularly measles, may produce another adenoid.

Hæmophilia is a counterindication to this, as to all other cutting operations, and weak, anæmic children, together with those suffering from syphilis, tuberculosis, or other constitutional disease, should undergo a course of roborant treatment preparatory to the operation, so that it may confer the greatest benefits. Counting out the few cases to which these cautionary remarks apply, we may confidently advise the thorough extirpation of adenoids, both for the relief of the palpable obstruction of the breath-road, and for the far reaching effects upon many organs and many functions; there are, indeed, few surgical procedures which have to their credit so many beneficent results.

Thoughtful attention to all preliminary details will do much to secure a successful, well-finished operation. As a precaution against profuse hæmorrhage and as affording a better chance to complete the work at one time, I prefer general to local anæsthesia. The inhalation of ether is usually very satisfactory, for if the patient has been properly prepared, the nausea and other unpleasant sequels are reduced to a minimum and there is very little danger of postoperative accidents. It must be remembered that the patients are young and free from those degenerative changes which, in the later stages of life, often make general anæsthesia unsafe.

Upon the day before that fixed for the operation, the blood should be subjected to the coagulation test and the urine examined. If the patient's general condition appears to be normal, he should take a cathartic at bed time and this should be supplemented, if necessary, by an enema, the following morning, the object being to have the alimentary canal empty. With this end in view, no solid food should be taken upon the day of operation, any craving of hunger being relieved by milk, and even this should be avoided for a prior interval of three hours. The bladder should be emptied just before the anæsthetic is given. If the operating table can be placed near a large window or under a skylight, so that direct rays may enter the naso-pharynx, it will be possible to work by sunlight, other-

wise use must be made of artificial light, reflected from the head mirror. The table should have a head piece which can be lowered; if this is lacking, the patient's body must be raised (folded blankets or other extemporized support) so that the naso-pharynx will be on a lower level than the larynx, when the patient lies upon his back. The purpose of thus elevating the chest is to hinder blood from entering the larynx and the neck need not be bent far back; for a slight difference of level will prevent any escaping liquid from going into the trachea and turn it into the œsophagus, lying immediately underneath.

With the patient extended in the dorsal posture, with lowered head, the jaws are widely separated and a mouth-gag inserted between the teeth; then the surgeon's index-finger is introduced into the naso-pharynx, to make a final exploration and to corroborate, or correct, the findings of previous examinations, as to position, size and attachments of the growth. The finger is now withdrawn and a non-fenestrated tongue-depressor, held in the left hand, is used to draw the tongue forward and retain it in that position, in order to secure an unobstructed view of the fauces and the posterior wall of the pharynx. Holding the closed Brandegee forceps in his right hand, the surgeon introduces the instrument upon its side, so that the curved blades pass through the fauces with their points directed toward the right wall of the mesopharynx; the shafts of the forceps traverse the mouth, and the curved handles project across the cheek, pointing toward the patient's left ear. When the blades reach the retropharynx, the handles are moved through an arc of ninety degrees, taking their place in the median line, in front of the chin, and this motion rotates the shafts and raises the blades to an upright position in the naso-pharynx posterior to the velum palati. The forceps blades are now separated, pushed further back and brought toward each other, grasping the growth, their sharp edges sink into the mass, which is gradually severed from its attachments by a rocking, twisting motion of the handles. Position of forceps is shown in Fig. 68. The purpose in view is to remove as much of the mass as possible

with the forceps and, when it is of moderate size and has fairly well-defined edges, nearly all may be engaged in the fenes-

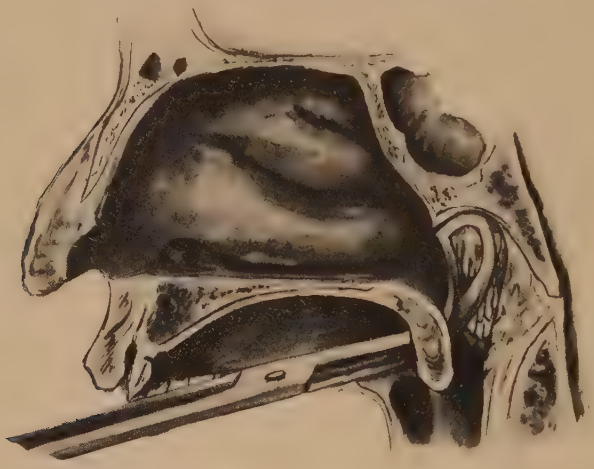


FIG. 68.—The Brandegee forceps grasping a mass of adenoid.

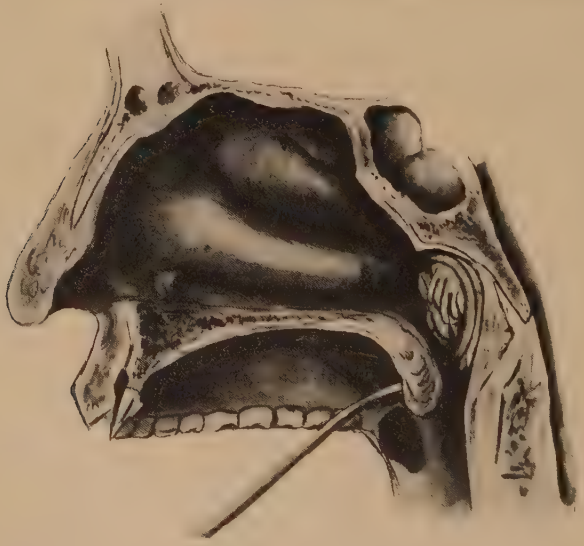


FIG. 69.—Removal of Adenoid completed with curette.

trated blades and brought away, when the instrument is withdrawn from the mouth. This is a very satisfactory result

which cannot always be obtained, for the growth may have fringe-like adhesions upon the pharyngeal wall below and also laterally. In such cases, we must be content to have the forceps remove the upper and anterior part and to complete the work with the curette which should scrape away all the morbid tissue, caution being used, of course, to prevent injury to normal structures. The Eustachian eminences can be avoided by keeping the shafts of the forceps and curette in the median line and the nasal septum will not be endangered if the shafts are raised close to the upper incisor teeth. The curette *in situ* is shown in Fig. 69.

After the curettement, the index-finger is again introduced and any adhesions to the Eustachian eminence, or elsewhere, are broken down; if this examination discloses any remnants of the growth, these must be cleared away with the curette. After these procedures, a long, curved hæmostat holding a piece of picked gauze, is introduced and sufficient pressure made upon the surface, denuded by the operation, to control the bleeding. This can usually be done in three or four minutes, when the gauze may be removed. The patient is returned to bed where he should remain for twenty-four hours. For twice that length of time, use should be made of a special diet, very bland and unstimulating, after which there may be a gradual return to the food habitually taken. No further local treatment is usually required.

CHAPTER XVI

NASO-PHARYNGEAL NEOPLASMS

The neoplasms found in the naso-pharynx may be of either the benign or the malignant kind and they appear to depend upon the same causes, which produce similar growths in the nose. On account of the anatomical features of this region, there are some symptoms, which are common to all naso-pharyngeal tumors. There is obstruction, slight or serious, to respiration, the voice is altered by encroachment upon the vault, the patient has a more or less persistent inclination to clear his throat of mucus or muco-pus, whose presence is due to the coincident catarrh, and he often feels as though a foreign body were lodged between the nose and throat. Sleep is apt to be restless and accompanied by snoring; hearing is frequently impaired upon one or both sides, either by the extension of catarrh to the middle ear, or by pressure on the Eustachian tubes. As the tumor grows larger, its anterior extension may bear against the soft palate, embarrassing its functional movements and making swallowing difficult; *pari passu* with this growth, interference with normal breathing increases and air must be admitted through the mouth. Very large tumors of firm, dense consistency may produce erosion of surrounding tissues and even cause absorption of the bony walls subjected to their pressure. In malignant growths, the symptoms mentioned are supplemented by pain, recurrent hæmorrhages, fœtor of the breath, enlargement of the cervical glands and the cancerous cachexia; the last two signs appearing in an advanced stage and indicating metastatic infection.

Differential diagnosis depends chiefly upon posterior rhinoscopy and digital exploration. Polypi (Fig. 70) which are frequently encountered, are reflected in the postnasal mirror as

pyriform bodies, pale in color and semi-translucent; to the finger they impart the sensation of smooth, soft, yielding masses, moving readily on account of the flexibility of the pedicle, which holds them. Fibromata, also very common, are dense, highly vascular tumors, composed mainly of connective tissue. In the mirror they show a dark red color and a surface marked by furrows, or lobulated; to the digital touch they seem hard, firm, almost immovable. They often grow to a large size and, though not primarily malignant, are apt to undergo a cancerous degeneration.

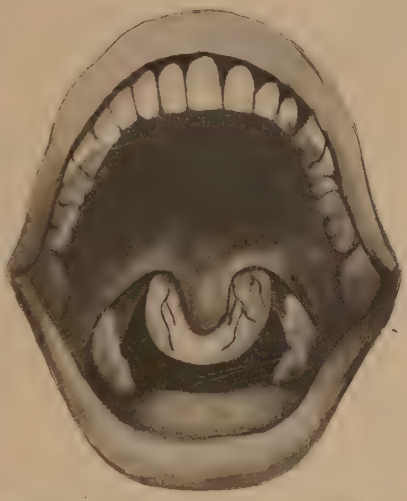


FIG. 70.—Fibro-cystic polypus in vault of the pharynx.

Among the less common benign neoplasms are papillomata, chondromata and adenomata. The malignant type is represented by sarcoma and carcinoma, which have the same characteristics in the naso-pharynx as in other situations. If the diagnosis is not positive, if there is a shadow of doubt regarding the nature of the tumor, local anæsthesia should be induced and a specimen cut from the growth and at once examined for the evidence of malignancy. As the only possible hope lies in very early extirpation, it is wholly unjustifiable to wait until hæmorrhage, pain and involvement of the cervical glands establish a symptomatic diagnosis.

The only rational and efficient treatment for tumors of the naso-pharynx is their thoroughgoing removal. In many cases, this can be done with the cold wire snare. In children general anæsthesia is required, but the local method answers very well for those who are older. The wire snare is to be introduced through either the nose or mouth and brought into a position

where its loop can be passed over the tumor so as to encircle it. This adjustment of the loop is aided by manipulation of the postnasal mirror; or by the surgeon's index-finger. The loop should be carried up over the tumor's pedicle or other attachment, as close as possible to the base, and the morbid mass dissevered by gradual constriction of the encircling wire. After the part ablated by the snare has been withdrawn through the mouth, any remainder is removed with biting forceps, or a curette. Sessile or very small growths, which cannot be engaged in the loop of the snare, can be scooped out by a sharp curette. The postoperative treatment is similar to that following adenoidectomy.

In large malignant tumors and in some non-malignant growths, which have been neglected until they have attained a great size, it may be impossible to effect removal through the natural passages and the only alternative is resection of the upper jaw, making an opening through the hard and soft palate large enough to permit the separation of the tumor from all its attachments and the extirpation of every particle of morbid tissue. This is an extensive and difficult operation and should not be undertaken without fully considering, and frankly explaining to the patient, the risks involved. No skill or prudence can eliminate the dangers of death from shock; from asphyxia, from hæmorrhage, or from pneumonia. Nevertheless, in the absence of malignant infection of the system, this operation is justifiable and, in a number of cases, has saved the patient's life and, together with plastic restoration of the upper jaw, has secured for him freedom from suffering and a state of comparatively good health.

Where malignant infection of the system has already taken place, surgery can accomplish nothing. Our only resource is to adminster narcotics, particularly opium and its alkaloids, to diminish, as far as possible, the patient's sufferings; to gain for him the mitigation of euthanasia.

CHAPTER XVII

PHARYNGITIS

The part of the throat below the naso-pharynx is the narrower section of the cylinder giving coincident passage to the breath-road and food-road. It joins the mouth through the arch of the fauces, the largest of the seven pharyngeal orifices, and at its lower extremity connects with the larynx and the œsophagus, the latter tube being a continuation of the cylinder reduced in size. Anatomically this section is very similar to the naso-pharynx (Chapter XIII) except that its epithelium is squamous, instead of ciliated, and the mucous glands so numerous above the plane of the palate are here more sparsely distributed. The chief function of the pharynx is to furnish a warm, moist, resilient passageway for solids, liquids and gases upon their course to the lungs or the stomach.

The mucosa and underlying tissues are often the site of various inflammatory affections, whose predisposing causes are numerous, but whose chief excitants are sudden reductions in temperature and abrupt changes in atmospheric pressure, producing marked contrast between densities inside the body and those outside. It is this barometric change which puts a strain upon the mucosa, which is a thin partition between the intrasomatic and extrasomatic spheres of pressure; and this strain produces most of the effects popularly attributed to dampness. The climate of the eastern and middle states, which is noted for great and rapid changes in both the thermometer and barometer, is conducive to pharyngeal disorders and it is not strange that they are common: indeed, as one author remarks: "When we consider that air, food, and drink of all kinds, and at many temperatures, enter the pharynx and also remember the climatic conditions, we are

not surprised that so many persons have sore throats, but rather that so many escape."

Among people of American stock these pharyngeal affections are less prevalent than during the first half of the last century, as is shown by the medical literature of that time. The change is doubtless due in part to more hygienic habits of life, particularly to the disuse of the neck cloth of many folds, long in fashion, which kept the throat muffled up in a very irrational way; but I think it largely depends upon a racial tolerance gradually acquired, by which the body gains a certain immunity in regard to climatic influences. Emigrants from the south of Europe, where the climate is comparatively uniform, are very liable to these disorders, which were quite rare among them in their old home.

Pharyngitis may exist alone, or may be associated with rhinitis or tonsillitis; in fact, with inflammation of any, or all, parts of this region, where morbid processes find ready means of extension by continuity of surface. Predisposing causes are the rheumatic and gouty diatheses, sedentary habits with lack of muscular exercise, alcohol and tobacco, inadequate ventilation, especially of sleeping apartments, and whatever impairs gastrointestinal digestion, leading to imperfect metabolism and the production of enterogenous toxins. The infectious diseases, such as syphilis, tuberculosis and influenza produce manifestations in the pharynx, which are more logically enumerated among local exhibitions of the constitutional malady than among etiological factors of the throat affection. Improper use of the voice is really an exciting cause, whose influence is limited to public singers, speakers and others who make occupational use of the vocal organs.

In the acute or catarrhal type of the disease, the first symptom noticed by the patient is dryness of the throat. This is sometimes recognized as the aggravation of an uncomfortable sensation habitually present, the patient declaring that his throat is always dry, but now feels parched. This symptom merits special attention, for the habitually

dry throat, the *mucosa sicca*, is often an early sign of Bright's disease, or of diabetes. It may have other origin, but it should prompt inquiry regarding these maladies, at least the taking of the blood pressure and the tests for albumen and for diabetic sugar. Together with the feeling of dryness, there is a sense of rigidity as though the muscles of the throat and neck were stiff, though the actual decrease of motility is slight, far less than in torticollis. To these symptoms there is soon superadded pain. While the muscles are at rest this is usually dull and is often described as a deep-seated soreness; but it is increased by muscular action, so that swallowing, coughing and speaking may render it quite acute. The voice takes on a more or less harsh, muffled quality, due, in part, to the patient's fear of pain, which makes his voluntary phonation imperfect, and in part to some extension of the inflammation to the larynx. There is usually a rise in temperature of from one to three degrees with a corresponding acceleration of the pulse. Pharyngoscopy shows, during the first stage, a dry, tense, glazed surface; later, when secretion has been established, the mucous membrane is bright red with adherent patches of mucus, or muco-pus. If the uvula be involved, its loose cellular tissue becomes œdematous, imparting a sensation that there is a foreign body in the fauces, so that the patient makes repeated, though futile, efforts to clear his throat. The uvula may increase to such a size as to threaten suffocation and to necessitate lancing or amputation. When the inflammation begins to decline, the stages of recovery are similar to those observed in defervescence, wherever mucous tissues are concerned.

In treatment, constitutional measures should be prompt and decided. The time-honored teaching, that at the outset of all acute diseases the alimentary canal should be cleared, is especially pertinent here, because pharyngitis is nearly always associated with faulty digestion and disordered metabolism. A tablet containing half a grain of calomel and two grains of sodium bicarbonate should be administered each hour, until

four have been taken. These are to be followed by a saline whose strength should be adapted to the patient's susceptibility (in which individuals differ widely) so that there may be free, but not drastic, catharsis. The patient should go to bed and remain in a state of entire physical and mental inactivity, until the return of a normal temperature signalizes defervescence. A warm bath during the first four hours is a useful adjuvant. In mild cases this treatment is often all that is required. Patients may refuse to go to bed because they think they are but slightly ill and cannot afford to interrupt their work, but this method of elimination and quiescence is the rational plan and, as such, saves time, suffering and danger.

When the attack is of a graver sort and does not yield readily, its persistence often depends upon changes in the blood due to disordered metabolism. Sodium salicylate, ten grains, may be given at intervals of four hours, and fifteen grains of potassium citrate, largely diluted, two hours after the other dose, until correction of urinary hyperacidity shows that the remedies are taking effect. If temperature goes above 102° F. tinct. aconiti rad. ♏ x, two or three times during the twenty-four hours will be found useful. Ten grains of Dover's powder at night will generally alleviate the pain in rheumatoid cases, but in very sensitive patients who are kept awake by suffering, it is better to administer a sixth or a fourth grain of morphine hypodermically, than to subject them to the depression of pain and insomnia combined. The diet throughout must be bland, unstimulating and of laxative tendency; plenty of water should be taken and active elimination by the kidneys maintained.

Local treatment is required in all cases, except those which yield promptly to rest and purgation. The cold compress upon the throat often diminishes the pain. An alkaline wash, such as Dobell's solution, should be used as a spray within both throat and nose, to cleanse the membranes from tenacious secretions and to promote resolution. Benefit will be derived from the use of lozenges, which by gradually dissolving, keep their ingredients in prolonged contact with the affected tissues.

Either of the following may be employed: Tinc. ferri chlor. ♏ j; potas. chlorat., potas. bromid. āā gr. ijss; M.—Ext. krameriæ gr. ijss, cocaine hydrochlorat, gr. 1/12, potas. chlorat. gr. ijss; M. For œdema of the uvula the solution of epinephrin chloride, 1: 1000 should be used; if it fails, the distended membrane should be scarified.

Chronic pharyngitis, called also hypertrophic, granular, or lacunar pharyngitis, and clergyman's sore throat is essentially a prolongation of the catarrhal form, with the addition of features resulting from continued congestion of the mucous and submucous tissues. It is very frequent in patients who, having an acute attack, resume their occupation and discontinue treatment before their cure is complete. This is often done in accordance with the mistaken notion that one can "fight down," a disease, a prolific cause of chronic and incurable disorders.

The morbid conditions present in this type of pharyngitis are those infiltrations and hypertrophies which result from long continued congestion. They closely resemble the intranasal alterations following protracted rhinitis, already considered, with the special feature that the tubular glands of the pharynx become filled with a caseous exudation and together with the enlarged lymphoid cells surrounding them form nodules which appear as slight, rounded elevations above the surface of the mucous membrane. There is also beneath the mucosa a proliferation of connective tissue. The symptoms include continual discomfort in the throat and a tendency to hawking and coughing, sometimes with and sometimes without, expectoration; an unpleasant odor of the breath and considerable change in the quality of the voice which also shows marked weakness upon any attempt at prolonged vocalization, in either speaking or singing.

In this disease much importance attaches to a thorough and patient study of the etiology. Many causes may contribute to its production and it is only by their discovery and by apprehension of their influence, as etiological factors, that we can

formulate a rational plan of treatment. One group of causes is occupational. Where men work in an atmosphere charged with smoke, dust, sand, or the fumes of volatilized chemicals, some throats will be affected to various degrees, though some suffer little, or nothing. We cannot expect cessation of effects, if a cause continues to act, hence pharyngitis due to the inhalation of irritants, such as those mentioned, cannot be cured unless there is a change in occupation. Among occupational causes stands the improper use of the voice,[1] a subject of much interest, since it was long regarded as the chief reason for lacunar pharyngitis, bringing into general use the Latin and English synonyms: dysphonia clericorum, and clergyman's sore throat. In the first half of the 19th century, this disease was so prevalent that if a minister relinquished preaching, his act was commonly attributed to "throat trouble" and, in some denominations, more than forty per cent. of the pastors were reported as more or less afflicted in this way. Only a small fraction of that number are now attacked by the disease and so great a change points to some radical difference between the antecedent conditions in that period and our own, but no one appears to have found, or at least published, an adequate explanation. The rheumatic and gouty diatheses also play a part in the etiology and cases are reported where long-continued residence at Carlsbad and other spas for rheumatic patients

[1] A study of vocalization, as practised in different occupations, constrains one to think that no harm is done to the throat by long-continued speaking, by loud speaking, or by out-of-doors speaking, provided a proper method of phonation be discovered and pursued. Many clergymen are (or were formerly) sufferers from lacunar pharyngitis, attributed to their preaching three or four times weekly, although the aggregate length of their sermons was not over two or three hours; yet the auctioneer speaks in loud tones for several hours, each working day, and seldom incurs any injury. The street vendor, whose peculiar, nearly inarticulate cry may be heard for two blocks, uses his voice all day long, out of doors, in all weathers, yet at night-fall, he is not sick, nor even hoarse. This man knows nothing of anatomy or physiology, but he has, in some way, developed a method of phonation which enables him to avoid injury. If these vendors substitute plain, comprehensible speech for their peculiar, sing-song cry, they tire in an hour or two; but, with it, can go on all day. The reasons for this deserve more investigation than they have received.

has brought about the cure of pharyngitis, which had resisted all topical medication. Finally nasal and naso-pharyngeal obstructions and abnormalities are important causative factors, and deflections, deformities and hypertrophies should receive surgical treatment; very often their correction is the precursor of rapid improvement in the pharynx.

In addition to the therapeutic measures indicated by what has just been said of the etiology, there are several topical remedies whose employment in connection with constitutional and surgical procedures will do much good, although when used alone, their effect is in the main palliative. Cleanliness should be secured and maintained by spraying the pharynx with an alkaline solution, *e.g.*, Dobell's. When there is much relaxation, a solution of alum, ten grains to the fluid-ounce, proves a good astringent spray. A more active treatment consists in using upon a cotton-tipped applicator a solution of silver nitrate, ranging in strength from two to six per cent. according to circumstances or the iodine solution No. 1 described in Chapter VII. In cases of long standing the tubular glands and the lymphoid cells upon their walls have degenerated to such an extent that they should be extirpated. When this is to be done, the protruding nodules, indicating the location of the glands, should be desensitized by several paintings with an eight per cent. solution of cocaine and then desiccated by the galvanocautery electrode at a cherry-red heat. Only a few nodules should be devitalized at one sitting. Chromic acid or the curette may be used instead of the cautery. The denuded spots, under the eschar, heal by granulation; during this process the proximity of irritant substances should be prevented, as far as possible.

CHAPTER XVIII

THE UVULA

The uvula is a slender coniform process with its base attached to the center of the soft palate. It is free and pendulous occupying the middle of the oropharyngeal orifice and approaching within half an inch of the tongue, when the head is erect. It has a covering of mucous membrane with squamous epithelium and interiorly consists of a cellular substance traversed by strands of connective tissue and fibers from several muscles, the more important being the levatores palati and the tensores palati. Its blood supply comes from small arterial and venous branches (palatine) but these become recurrent several millimeters short of the free extremity, the lower segment having only minute capillaries; so too the terminal part is devoid of muscular fibers. These anatomical peculiarities are important pathologically and surgically. In œdema of the uvula, the serum which distends the pendulous bulb, extending to the mesopharynx or beyond, does not come from the coats of the bulb itself, but from the vessels higher up whose leakage gravitates to the lowest point, and an incision through the walls of this bulbous sack, while giving vent to the imprisoned serum, will draw but little blood, if the cut extends no higher than the boundary of the lower segment comprising a third of the length. The uvula is sometimes very short on account of arrested development. Sometimes there is bifurcation in the median line, a cleft extending from the apex to the base. This is a slight manifestation of the anomaly which in its serious form constitutes cleft palate or hare-lip. These deformities result from failure of the two halves of the palatine structures to unite, as they do when development is normal. Persons with very short

or bifurcated uvulas appear to suffer but little inconvenience. They possess the average facility in breathing, speaking and swallowing. Whatever may be the physiological function of this part of the palate, it cannot be of great importance and, in the present state of our knowledge, is a matter of conjecture.

Uvulitis may appear as a primary disease, the other parts of the throat being unaffected, but it much more commonly arises secondarily in consequence of tonsillitis or pharyngitis, continuity of surface and similarity of structure greatly facilitating the mutual extension of morbid action from organ to organ. The symptoms vary much in different patients, because some persons can tolerate an enlarged uvula with nothing more than occasional discomfort, while the sensitiveness of others brings on nausea and even vomiting, particularly in the morning, together with a persistent cough. This cough has in many instances given rise to a dread of tuberculosis of which it is hard to disabuse the patient's mind by assurances that no lung disease is present. Under such circumstances, active measures should be employed to effect a prompt cure, or the sufferer is apt to fall into the hands of a charlatan who will foment his fears, while they prove profitable, and, when the patient grows restive, will shorten the uvula and thus effect a "wonderful cure of advanced consumption, in the very nick of time." In uvulitis visual examination shows the organ to be elongated, swollen, œdematous and bright red in color, the distended wall exhibiting a glazed surface with patches that appear semi-translucent. It may be long enough to touch the larynx and large enough to obstruct the breath-road very seriously, even to the point of suffocation.

The treatment of mild cases, where the inflammation is recent and nonseptic, need comprise nothing beyond the evacuation of the accumulated serum and constriction of the uvular pouch, to prevent recurrence of the engorgement. After irrigating the throat with Dobell's solution, or a similar

alkaline wash, a straight, sharp-pointed bistoury should be used to scarify the distended sack. Four or five punctures should be made very quickly, then the head should be bent forward and the escaping serum drained away by gravity, or ejected by expectoration. A few small holes are sufficient for the escape of the contents which are entirely liquid, and these minute punctures, closing at once by contraction of the mucosa, are better than larger incisions, admitting the air with the possibility of inducing suppuration. After the serum has escaped, the collapsed, shriveled membrane should be painted with an eight per cent. solution of tannic acid in glycerine which acts not only by the astringency of the tannin, but by the hydroscopic property of the glycerine that takes up any water which may exude from the interior of the sack. This application can be used daily and, in the intervals, a spray of solution of epinephrin chloride whose strength is one to ten thousand. These measures often prove curative for simple catarrhal uvulitis, in the course of six or seven days.

Chronic uvulitis, with elongation, presupposes such lengthened continuance of the morbid state, that the distended wall has lost its elasticity and, although scarification may render it flabby, there is little shortening effected by either the knife or astringents, and there remains a vermiform membrane, pendulous and flaccid, lying upon the tongue, or oscillating in the laryngo-pharynx and provoking cough, nausea, perhaps pharyngalgia. When this condition is established, the lower segment of the uvula acts as a mechanical irritant, much as if it were a foreign body suspended and motile, hence very little can be accomplished with pharmaceutical remedies: the irritation will continue, as long as the irritating body remains, therefore, the superfluous part of the uvula, the abnormally elongated segment, must be amputated.

For this operation the patient should, as always, be carefully prepared, the surgeon making sure that there is no valid counter-indication to the procedure contemplated; then the

throat is cleansed and local anæsthesia induced by painting the operative field with an eight per cent. solution of cocaine applied by a cotton-tipped carrier. As the anæsthesia is local and the patient is fully conscious, it is best for him to sit erect in a chair having an adjustable head rest.

This amputation involves at the start a choice of implements in accordance with the purpose to use one-handed or two-handed instrumentation.[1] One of the best known single-hand devices is the uvula scissors of the late Dr. Carl Seiler. He invented them to meet the exigencies of the old-time dispensary service in which a surgeon had very little help from trained assistants. To keep the operator's left hand free, while the right hand performed the amputation, was a leading purpose of Dr. Seiler. In describing the instrument he says: "The handles are curved so that the hand holding them is below the level of the patient's mouth (upright posture); the right blade is bent at a ninety-degree angle, so there is a hook near its end; the left blade is straight and extends to the upper margin of the right blade where it is bent. When the blades are separated a triangle is formed through which the uvula drops and is severed near its base when the blades come together. It is prevented from slipping backward out of grasp by the hook-like bend of the right blade. The amputated piece is caught by a pair of pronged claws attached to the pivot on the under surface of the instrument." The inventor who had remarkable talent as a mechanician thought highly of this instrument and performed a large number of operations with the original model which was

FIG. 71.—Seiler's uvula scissors. Amputation of the enlarged bulb can be performed by using one hand only.

[1] This is a choice presented in a number of operations and a surgeon's preference is influenced by personal considerations, largely by his dexterity with his left hand which seems like a pun, but is quite important.

made under his close, personal supervision. In his opinion and in that of his co-workers this implement was almost perfectly adapted to the purpose in view. In our time surgeons cannot always secure by this operation the neat and well-finished results described by Dr. Seiler and their disappointment may be due to the instruments used. Those upon sale in the shops differ among themselves, as is common with implements of complex construction, and a slight variation may affect operative details. The instrument which we buy is not an exact duplicate of the model which satisfied Dr. Seiler's very critical

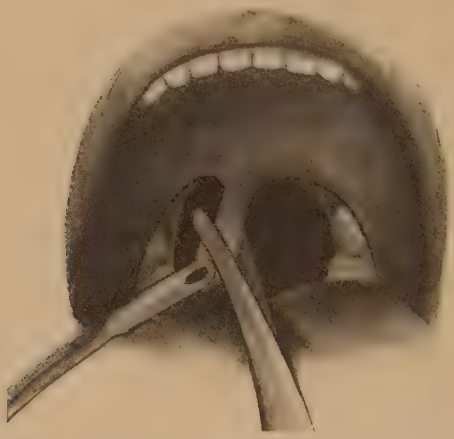


FIG. 72.—Shortening an elongated uvula; bimanual operation.

judgment and with which he performed his operations. We cannot expect the results to be identical. Fig. 71 shows an instrument intended to combine the features described by Dr. Seiler.

In a majority of cases I prefer the bimanual technique, employing grasping forceps and straight, blunt-pointed scissors. The preparation of the patient and the anæsthesia are those already described; then the tip of the uvula is seized with the forceps, enough tissue being taken between the blades to give a firm hold. With the forceps in the left hand, traction is made toward the front of the mouth, so as to put the uvula

upon a stretch. The redundant portion below the muscles and blood vessels is amputated with scissors held by the right hand, the incision running from before backward and from below upward. This produces a beveled surface with the raw side at the rear and prevents food and drink impinging upon the wound. If unusual bleeding occurs it is checked by the eight per cent. solution of tannic acid in glycerine or a slight touch of the galvanocautery. Until healing takes place, the diet should be unstimulating and bland and care should be taken that nothing enters the mouth which could exert a toxic influence upon the granulating surface. Fig. 72 depicts the bimanual procedure.

CHAPTER XIX

THE FAUCIAL TONSILS

The faucial tonsils, situated in the trianguloid cavity between the pillars of the fauces, bear their descriptive name to distinguish them from the pharyngeal and lingual bodies of similar structure; but they are commonly termed simply the tonsils and when the name is used alone, the faucial tonsils are always the ones intended. They are glandular bodies, in shape somewhat like an almond, a resemblance leading to the name amygdalæ which they bear in several languages. The tonsils grow rapidly during childhood, reaching their full size at puberty or soon afterward, and at this period they are most susceptible to disease. In common with other lymphoid structures they undergo atrophic changes after the body attains maturity, and in middle life they are generally small, fibrous and ischæmic, showing little activity of any sort. This change does not occur in everyone. Some persons past fifty still have large, vascular tonsils subject to inflammatory attacks. The death of Washington was attributed by his physicians to acute tonsillitis or quinsy, the name by which the disease was then designated; but some critical historians doubt the accuracy of the medical report.

In size the fully developed tonsil shows much variation in different individuals; the length of its greatest diameter, as given by anatomists, is from three-fourths of an inch to an inch; the weight including the capsule is from 90 to 120 grains. The largest measurements found upon record pertain to a pair of tonsils which I removed from a youth of nineteen years. The larger was two inches long and weighed 265 grains; the smaller was a little less than two inches in length with a weight of 217 grains. These extraordinary dimensions were due to

hypertrophic enlargement, which had been progressing for years and had produced very distressing and dangerous symptoms.

The tonsil consists of a cellular mass interlaced by fibers of connective tissue and liberally supplied with blood coming from ramifications of the lingual, facial, internal maxillary and external carotid arteries. Its body is enveloped by a fibrous capsule, which is incomplete on the side toward the uvula, where are found many orifices leading into the crypts or follicles distributed through the interior of the organ. These crypts are lined with mucous membrane whose normal secretion, here as elsewhere, is liquid and readily escapes from the orifices. In disease, however, it becomes thick and mingling with morbid products produces a caseous mass of a yellowish-gray color which fills the crypts and even spreads over the spaces between them. Lymphatics connecting with cervical glands bring the tonsil into association with the general lymph circulation.

The physiology of the tonsils is undetermined. Many suggestions have been made: perhaps it has some prenatal function; perhaps it is a vestige of some obsolete organ; perhaps it modifies the secretions of the ductless glands carried in the blood plasma. These conjectures are offered because many believe that the existence of an organ necessarily implies a function for that organ.[1] As a matter of fact, we do not know whether the tonsil has a function; if there be one, it cannot be important, for there is no proof that deprivation of the tonsils has injurious consequences. Operative accidents may do harm but accidents are no impeachment of the operation itself. In the present state of our knowledge we cannot assert that any useful function is performed by this organ. When we consider negative physiology the phenomena asso-

[1] "In natura stat nihil inutile: quod adest, idem prodest." This old argument has influenced many minds and has stimulated an earnest search for functions, with good results. Admitting that the tonsil has a function, we have gained nothing, until we know what it is. If the organ were left in place we would be liable to do many things detrimental to a function of which we possessed no description.

ciated with an organ, which do not assist the action of other organs, do not promote the health of the whole body but induce disorder and favor disease; then the activity of the tonsils is beyond question. There is no doubt they are gateways for pathogenic germs carried by food, drink and air, which not only are the causative factors in the pathology of the throat affections, but also enter the blood vessels and lymphatics, migrate to distant parts of the body and originate nephritis, orchitis, adenitis and other maladies. The tonsillar crypts also serve as receptacles for procrastinating microbes of some of the infectious fevers, particularly diphtheria, so that a convalescent, who has no longer any symptoms of the disease, is still a carrier of contagion. The dormant germs may continue inactive for a long time and then suddenly manifest all their pristine virulence.

The evil effects of tonsillar disease are either obstructive or toxic. Enlargement, from whatever cause, soon produces mechanical interference with the food-road, and secondarily with the breath-road. Even a moderate augmentation in the size of the organ serves to constrict the oropharyngeal orifice and gives rise to dysphagia; because the tonsil's anatomical situation is such that, when enlarged, its extension must be almost wholly in one direction, that is, toward the median line of the fauces and a swelling, which would appear moderate if concentrically distributed, is sufficient to encroach seriously upon the open space and, if both glands are affected, to close the passage. If the enlargement goes on after the food-road has been occluded, the tonsils are forced to bulge backward into the meso-pharynx and the passageway is further narrowed by the engorgement of the palatine and pharyngeal mucosa made œdematous by pressure. These changes obstruct the breath-road along its course from the posterior nares to the larynx and the obstruction is increased by the thick, mucous secretion often produced abundantly and which, on account of its peculiarly tenacious character, adheres to the surface in large patches nearly as thick as a pseudo-membrane. If the œdema extends to the larynx, death is imminent and trache-

otomy is demanded. Aside from such complication fatalities are rare, but the embarrassment of respiration is great and very distressing to the patient. It should be promptly relieved and held in abeyance until the retrocession of the congestion relieves fear of further obstruction. To palliate this condition the tonsils should be freely scarified upon their anterior surface, the released blood serum (sometimes pus) running out over the tongue and being cleansed away from the mouth. The quantity of fluid which escapes is often surprising and the relief of the patient's distress is immediate. A single scarification is all that is usually required to obviate obstruction of the breath-road; but if much fluid again accumulates, it should be again evacuated. When the acute symptoms begin to decline urgent danger from respiratory obstruction is past; but we have to consider the effects of partial obstruction, together with other sequels of the recurrent and chronic morbid processes due to the action of toxins and, to some extent, of nontoxic irritants. The tonsil occupies an exposed position and its lacunæ give easy entrance to germs carried into the oral cavity hence micro-organisms are found associated with all tonsillar diseases. Even in acute, catarrhal tonsillitis smears show the presence of microbes, often representing many species including, of course, those which are habitually found in the mouth. These are ordinarily harmless but it is probable that they act as irritants when the tonsils are in a state of abnormal susceptibility, a condition produced by sudden changes in temperature and barometric pressure, whose effect upon the pharynx was discussed in Chapter XVII. The opinion that these nontoxic germs may irritate supersusceptible tissues is supported by the fact that tonsillitis may at its start be aborted by making an impervious coating of coagulated albumen upon the mucous membrane with a strong solution of silver nitrate applied on the convex surface of the gland, so as to coagulate the albumen of the mucosa and form an impervious coating sealing up the lacunæ for several days. The rational explanation appears to be that the caustic destroys the germs

which have already entered the epithelial layer and the coating prevents any others gaining access for the time being, until the special susceptibility has passed away after which they do no harm.

Acute tonsillitis is remarkable for the severity of its symptoms when compared with many diseases involving greater danger. Its mortality is almost nil but it may have injurious sequelæ and should not be regarded as trivial. It is usually ushered in by a chill followed by rapid rise of temperature, which generally reaches 103° and may go to 105° F. There is headache and backache with pain in the throat and as the swelling increases those signs of obstruction to the food- and breath-roads which have been already described. Albuminuria has been mentioned by some authors as an incident of the disease but it often signifies the onset of intercurrent nephritis caused by infections conveyed from the tonsil. The blood pressure should be taken whenever albumen appears in the urine and, if there be a rise of twenty millimeters or more above the average, it is a signal of the gravest import and a mandate to promptly antagonize the developing renal disease. At the beginning of an attack of tonsillitis, as of other febrile affections, the patient should be put to bed in a quiet room and the alimentary canal should be emptied by a mercurial cathartic followed, if needful, by a saline. A bowl of broken ice should be within the patient's reach and fragments kept in the mouth; a simple expedient which does a great deal to assuage thirst and lessen discomfort. Medication by the stomach is possible only before deglutition is interrupted by the swelling, or after its restoration, following scarification. This is true also in regard to feeding. During the severe stage little food is required; milk or broth with free drinking of water proves sufficient while the fever is at its height. The tincture of guaiac in doses of a fluidram, mixed with milk, should be given at intervals of six hours, for its alterative effect. The pyrexia is well controlled by tincture of aconite root, ♏x (dose for an adult), repeated every fourth

hour, until the pulse becomes slower and less resilient. Pain and restlessness are nearly always alleviated by a hypodermic injection of one-fourth grain morphiæ sulphate and $\frac{1}{150}$ grain atropiæ sulphate (adult dose), which also relieves the embarrassment of the respiration. Cold upon the outside of the throat, the "ice-bag cravat," may modify the course of disease, if applied before the formation of pus, while resolution is still possible. It is counter-indicated by suppuration. Washes of any kind are impracticable because of the turgescent and painful conditions, but advantage is derived from spraying the palate and tonsils with the usual three per cent. solution of hydrogen peroxide diluted with an equal quantity of water. This serves to detach and dissolve the tough, tenacious secretions adhering to the mucous membrane. A mixture of equal parts of tincture of iron chloride and glycerine applied to the tonsil with a cotton-tipped probe proves useful in some cases by its antiseptic and astringent properties. When pus forms it must, here as elsewhere, be given a free outlet.

Phlegmonous tonsillitis, peritonsillar abscess or quinsy, is a variety characterized by rapid and profuse suppuration, which usually infiltrates the soft palate and sometimes extends to the retro-pharynx. It is nearly always unilateral. The predominant indication in this type of the disease is to thoroughly evacuate the incarcerated pus. As soon as its presence is signified by fluctuation or other tokens an incision should be made at the spot where the abscess points, if this spot can be found; even if it cannot, there should be no procrastination, but the pus cavity should be penetrated at some place on the front surface. There is danger in delay, for the abscess may "point" posteriorly into the pharynx, which the swelling entirely hides from our view, and while we wait there may be a spontaneous rupture, discharging the entire accumulation into the larynx. This deplorable accident has occurred several times and is responsible for nearly all the fatalities reported in quinsy. In this variety the constitutional and topical treatment is similar to that

advised in the catarrhal, nonsuppurative type. The rheumatic diathesis predisposes to attacks of quinsy which, instead of protecting the patient against recurrence, really increase his susceptibility. During the intervals the salicylates or their derivatives should be administered, combined with alkalies, if the urine shows abnormal acidity. This treatment tends to postpone the occurrence of subsequent attacks and to render them less severe but is, after all, only a temporary expedient till the patient consents to a radical cure by the removal of the nosogenic organs.

As observed upon a previous page the injurious effects of tonsillar disease are either obstructive or toxic. Several varieties in which the second factor is prominent are now to be considered.

Follicular or lacunar tonsillitis (Fig. 73) is a form of the disease in which the crypts are chiefly affected. It is caused by pathogenic germs, especially the streptococcus, staphylococcus and pneumococcus. These invade the crypts and so affect the surrounding tissues that the spaces become clogged with devitalized epithelium, leukocytes and necrotic detritus of various kinds. The engorged crypts appear upon the tonsillar surface as dirty yellow spots, a characteristic sign, and a yellow secretion exuding from some that are overfull dries upon the surface and looks like fibrous bands. Sometimes the degenerating material is so abundant as to form upon part of the cortex a coating which somewhat resembles a pseudo-membrane but lacks its consistence, toughness and peculiar gray color. The subjective symptoms resemble those of the catarrhal form but are less acute. Metastatic infections of the Eustachian tube, middle ear, joints and cervical glands are sequels which occur not infrequently.

Treatment includes the constitutional measures of an antifebrile kind advised when speaking of the catarrhal form with such additions as special symptoms may require. Efficient action of the bowels should be maintained by giving calomel in small and frequent doses. Headache and mus-

FIG. 73.—Follicular or lacunar tonsillitis.

(*Facing page* 210.)

cular and joint pains can be mitigated by administering at two-hour intervals a powder containing: Acetanilid, gr. ij. and Acetyl-salicylic acid gr. v. Occasionally a small hypodermic injection of morphia may be necessary. The local exudate should be dislodged by the peroxide of hydrogen solution and the cleansed surface painted with equal parts of guaiacol and petrolatum liquidum, twice daily. Crypts which do not become normal under this treatment should be cauterized with solution of silver nitrate, ℥j to fl. ℥j.

Ulcerative tonsillitis, or Vincent's angina (Fig. 74) is differentiated from other varieties by its etiology. The disease is always caused by two germs, a fusiform bacillus and a spirillum forming a network over it. Both microbes were isolated by Vincent and bear his name. The symptoms are the same as those shown by other forms. The upper surface of the tonsil is first affected and the lower part may remain normal. The lesions are patches of gray film, due to necrosis of the mucosa caused by the invading germs and these patches have areolas of red, congested membrane. When the films are lifted, an ulcer is disclosed. This, if left to itself, may be again covered with a pseudo-membrane, or may extend into the surrounding healthy tissue and grow deeper by erosion at its base. As a germicide, tincture of iodine should be applied directly to the surface of the ulcers. It may be used daily and, after an interval of several hours, be followed by the application in the same way of an eight per cent. solution of silver nitrate. These remedies, employed with thoroughness, will destroy the germs, after which recovery will take place without further topical treatment. Constitutional conditions should receive attention as in other tonsillar inflammations.

Mycosis leptothrica is a morbid condition affecting the crypts and follicles of the faucial tonsils and liable to extend to the lingual tonsil and other lymphoid structures of the throat. It is caused by a fungus, called the leptothrix buccalis, which is common in the tartar upon the teeth and is thought to bear a causal relation to dental caries. This vegetation, while

showing little pathogenic power in its common oral habitat, has been discovered in association with diseases of very malign character; it has been found in the fæces during typhus fever and in the necrotic tissues of pulmonary gangrene. Perhaps its presence in such situations is accidental. Upon the mucous membrane it appears in clumps of rods or tufts of a white or yellowish color, distinctly raised above the epithelium and projecting abundantly from the crypts of the faucial tonsils, also frequently growing plentifully from the follicles of the lingual tonsil and other lymphoid bodies. This fungus is often present in the mouths of persons whose throats show no sign of its presence and it does not invade the fauces of those using tobacco, either as chewers or smokers. This curious fact probably explains why its tonsillar manifestations are much more common among females than males.

After a crypt has been occupied by the leptothrix for some time we find in its center a mass of horn-like tissue due to metamorphosis of the epithelium under influence of the fungus. From this hard, dense substance, the disease derives its alternative name tonsillar hyperkeratosis. This mass may take a conical shape with the apex protruding from the crypt and making indentations or abrasions upon softer tissues with which it is brought in contact. Inside the crypt the leptothrix is found in active growth and, together with it, other species of micro-organisms, often numerous and diversified, which find in the lacunæ conditions most favorable to their multiplication. The surrounding walls show remains of the epithelial cells which have nourished the bacteria and great numbers of which have been destroyed, while a few of unusual resistent power continue in a nearly normal state, in the midst of the necrotic detritus.

The patient may be made conscious of the existence of this horny mass, impinging upon adjacent structures, by the friction and abrasions above mentioned, which give rise to a pricking or tickling sensation; but, aside from such sensory impressions, the disease rarely causes any symptoms and its presence is

FIG. 74.—Ulcerative tonsillitis; Vincent's angina.

(*Facing page 212.*)

usually discovered during an inspection of the throat undertaken for some different purpose. This affection belongs to the period between puberty and fully developed maturity, being rarely seen after the twenty-fifth year. Commonly it is self-limited, running a course of two or three years and then disappearing spontaneously.

Treatment of a constitutional kind has no apparent effect upon mycosis and the only local measures which accomplish anything are germicidal applications, which destroy the fungus and its products. For this purpose the chemical caustics have been used and also the galvanic cautery. The plan I prefer is to render the tonsil insensible with cocaine and then to remove from the crypt decayed epithelium and all other detritus with a Buck dull ear curette afterward painting the partly emptied cavity with the iodine solution, No. 2, mentioned in Chapter VII (℞. Iodini, gr. xij, Potas. iodidi, gr. xxxvj, Glycerini, fl. ℥ viss. M.) and repeating the application daily, or upon alternate days, until the surface of the cavity begins to show a normal appearance; afterward at longer intervals. Under the influence of this powerful germicide and alterative, the less dense morbid growths disintegrate and, though the keratoid core of the mass in the crypt may resist the solvent action, it is loosened from the surrounding tissues and may often be readily dislodged with forceps. After its removal and the elimination of all degenerating structural elements from the interior of the crypt, the denuded surfaces are kept clean and encouraged to heal by granulation.

If only one or two of the lacunæ have been invaded by the fungus, this treatment may prove satisfactory and the cure may be permanent, but when the leptothrix has affected a large number of the crypts, the method described is open to several objections. The curettement and first iodinization are too painful to be done without anæsthesia and they consume so much time that only one or two crypts can be dealt with at a single sitting, hence the patient must undergo a series of operations, each one involving local anæsthesia, each one requiring

considerable time for the healing process. Such a series of surgical procedures requires an amount of patience and perseverance which many patients lack; they are apt to become discouraged and abandon treatment—a result unfortunate for both patient and physician. It is, therefore, best in multicryptic cases to advise the extirpation of the fungus in one or two lacunæ, where it is giving most trouble, but to present this as simply a palliative measure, preliminary to the radical and rational operation which effects a complete cure and makes recurrence impossible, viz.: the enucleation of the tonsil together with its capsule to be described in following pages.

Diphtheria (Fig. 75) is preëminent among the diseases whose tonsillar manifestations are serious on account of toxicity rather than obstruction (see former pages of this chapter). Obstruction does play a part in the clinical history, but its stage is the larynx rather than the fauces. Although a constitutional disease affecting the entire organism, diphtheria exhibits topical phenomena chiefly in the throat and nose and its germs are found in great abundance in these localities, while only sparsely in the blood and visceral organs. In considering the nasal form of the malady (Chapter VIII), its etiology and its treatment by antitoxin were discussed. Here it is only necessary to mention certain features which characterize its tonsillar manifestations. Of these the most conspicuous is that from which the disease derives its name ($\delta\iota\phi\theta\acute{\epsilon}\rho\alpha$ = membrane). This false membrane, of a dirty gray color and peculiar, repulsive odor, is found covering the cortex of the tonsils in nearly all cases where the pathogenic bacillus finds lodgement in the throat. It may spread to the soft palate, to the walls of the pharynx, and through the oral cavity; but the tonsils are nearly always the first structures affected. As this lesion can be seen at the beginning of the attack, it is a most important factor in making the diagnosis. There is only one disease[1] with which diphtheria is likely to

[1] I do not think scarlet fever raises a diagnostic difficulty. The absence of the false membrane and the presence of the strawberry tongue, scarlet eruption and very high temperature, are sufficient to identify it.

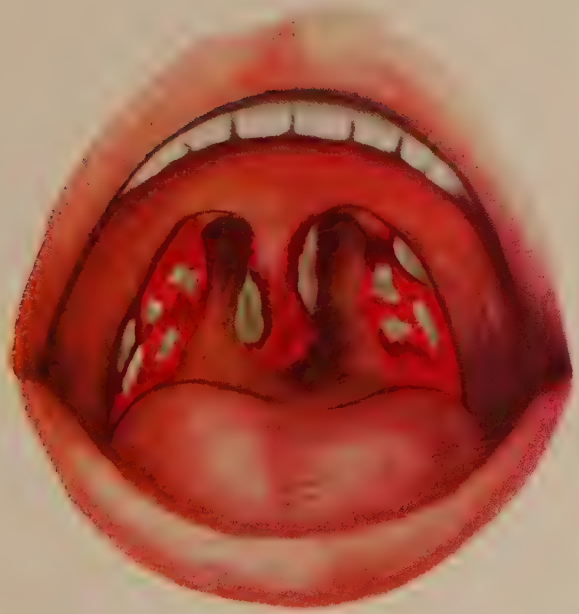


FIG. 75.—Diphtheria; patches of pseudomembrane on the tonsils and uvula.

(*Facing page* 214.)

be confused, that is follicular tonsillitis. The thick substance exuding from the overfilled follicles and spreading over the intervening spaces of the mucosa forms a coating which bears a resemblance to the pseudo-membrane. These similar manifestations can nearly always be differentiated by the following distinctive features, some of which are almost sure to be present.

Diphtheritic false membrane	*Exudate of follicular tonsillitis*
Spreads from tonsils to soft palate and elsewhere.	Confined to cortex of tonsils.
Color, a peculiar dirty gray.	Color, yellowish gray with streaks.
Tough and resistant; frayed edges.	Pulpy and easily broken.
Raw, bleeding surface left by removal.	Removal leaves red mucosa.
Peculiar, necrotic odor.	Odor slight or absent.

The cases are rare where an experienced physician, giving careful attention to these signs, proves unable to make a correct diagnosis; but if, after all details have been considered, there is still doubt as to the nature of the disease, then this doubt should be resolved by a bacteriological test. The finding of the Klebs-Loeffler bacillus in a smear taken from the tonsil will, of course, determine the question. When the constitutional symptoms are pronounced, prudence dictates that the serum treatment should not be held in abeyance while we wait for a laboratory report regarding the germs. It is better to administer a dose of antitoxin to a patient very ill with a form of tonsillitis, than to incur the risk of withholding it from what may prove to be a fulminating case of diphtheria.

Local treatment is useful in lessening the inflammation of the mucous membrane and ameliorating the patient's sufferings while the toxins are being eliminated. The nose and throat may be irrigated four or five times a day by employing a soft catheter attached to a fountain syringe or a rubber-bulb syringe of large capacity. Liquids thus used should be warm and should be very slowly injected. Among those well suited for the purpose are the normal salt solution and

a saturated solution of boric acid. The common three per cent. solution of hydrogen peroxide, diluted with thrice its bulk of lime water, may, when the mouth can be readily opened, be applied to the fauces with a swab. In a similar way use may be made of the following antiseptic and astringent mixture:

℞. Mentholis..... ℥iiss
Toluolis..... fl. ℥x
Alcoholis absoluti..... fl. ℥ij
Liquoris ferri chloridi..... fl. ℥j. M.

Chronic tonsillitis (Fig. 76) to which the names hypertrophic and hyperplastic also are applied is generally due to a succession of acute attacks, each one adding something to the deposit of products of inflammation and increasing the amount of connective tissue by which the normal cells of the organ have been superseded. By repeated distention the walls of the blood vessels lose their elasticity and their engorgement becomes permanent. The symptoms are those of chronic irritation. The patient has a "weak throat" and is never entirely well; he has always some faucial discomfort, always a liability to attacks of intercurrent diseases of a digestive, articular or nervous kind. When the morbid condition has lasted for a long time the tonsil may be brought to such an unhealthy state as to act the part of an obstructive foreign body. It is hypertrophied, engorged, indurated, germ-infested, so damaged by disease as to be little more than a mass of morbid tissue that is good for nothing and is a constant menace to the health of the organism. There are many stages between moderate tonsillar hypertrophy and this final detrimental state, and the trend of medical thought is to resort to the radical processes of surgery, at an early stage, rather than to allow the patient to suffer many acute attacks, waste much time and perhaps implant disease in other organs.

Three operations have been devised for the treatment of chronically enlarged tonsils. The first is the obliteration

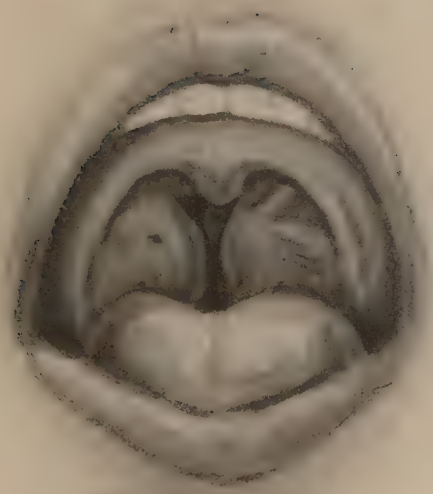


FIG. 76.—Chronic or hypertrophic tonsillitis. The tonsils here portrayed are those mentioned at the beginning of Chapter XIX, as the largest on record.

(*Facing page* 216.)

of the crypts, the particular purpose in view being the prevention of the entrance and dissemination of pathogenic germs. This procedure requires that each cavity shall be laid open and its inner surface be denuded, either by a specially devised knife or by the galvanocautery, so that the reparative process will efface the crypt. To reach all the crypts numerous operations are required and, while they certainly do fulfil their purpose by closing the gateway for infections, they are attended with serious disadvantages. They are painful and tedious, extending over many weeks, and patients are liable to become discouraged and to abandon treatment. Then, too, we cannot be certain that we have found all the crypts and immunity from infection is not attained until every one is obliterated. The value of the procedure seems to be limited to those persons who are affected by hæmophilia in whom all incisions however slight are attended by danger.

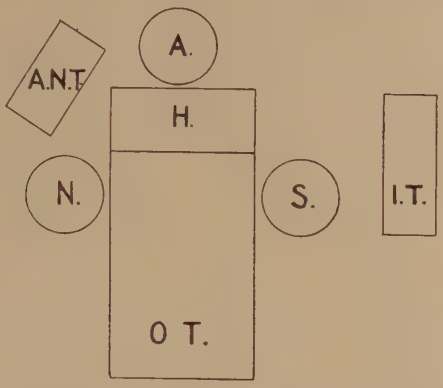
The second operation is tonsillotomy, the amputation of a segment of the gland including the cortex and more or less of the adjoining tissue. This was at one time a very popular procedure and it relieved many of the symptoms of an obstructive kind, which caused the patient much annoyance. It had, however, many drawbacks. The segment left by the amputation often became hypertrophied, protruded beyond the faucial pillars and brought back the old troubles, necessitating a second operation. Often the irritability of the fauces was but partially alleviated, the patient still had a "weak throat" and was still subject to recurrent attacks of acute inflammation. Besides all this, tonsillotomy proved a failure as a means of preventing infection. Crypts still existed in the remaining segment and in the capsule, furnishing breeding grounds for many varieties of bacteria, ever ready to migrate inward and to spread contagion throughout the organism.

For these reasons tonsillotomy has to a great degree been superseded by the more radical tonsillectomy and in many parts of the country is now seldom performed. There are localities where this operation is still frequent and is done by

nonspecialists, who consider it as included in general medical practice. This is a most mistaken view. If tonsillotomy is done at all, it should be done by one fitted for the task by training and experience. I know very well that, when a specialist makes such a remark, many think he is actuated by motives of self interest but the truth must be told in spite of sarcastic smiles and shoulder shrugs. It is not only because he is liable to wound the contiguous structures that the untrained, inexperienced physician should not attempt an operation of this kind; there is a graver danger; unwittingly he imperils the patient's life. The risk of serious hæmorrhage is always present in tonsillar amputation. This risk has been strangely minimized in our literature, perhaps because the authors thought their readers knew the facts anyway. Some text books make only a perfunctory remark like this: "After the operation any tendency to hæmorrhage should receive proper attention." The untrained man who reads such a statement naturally concludes that the danger is slight. It may be very grave. In general practice one encounters chiefly uterine hæmorrhage, pulmonary hæmorrhage and the bleeding from wounds of the upper and lower extremities caused by axes, saws and other tools. The arrest of such bleeding does not qualify one to treat a faucial hæmorrhage where the anatomical conditions are wholly different; and yet no one should operate in this region unless he knows how to prevent and how to arrest such a hæmorrhage. Fatalities due to this cause may be but seldom reported in the journals, but they are by no means rare.

The foregoing discussion leads up to the consideration of the operation, which in my opinion is the solution of the tonsillar problem; the operation of tonsillectomy, the extirpation, or entire removal of the organ. What remains to be said, will be told in answer to the questions when, why, and how. It can be said that the tonsils should be removed when they become troublesome. Repeated attacks of acute tonsillitis, recurring at short intervals, signify that the patient is very

susceptible and they presage a long series of illnesses, handicapping the youth in his educational course and the man in his vocation, with the addition of an undetermined danger of disability or even fatal complications. These things constitute a cogent argument, which is much stronger if chronic disease be already present. The date of the operation should be selected in the interval between acute attacks; the menstrual



Schema showing arrangements for enucleating the right tonsil.

O.T. operating table, upon which the patient lies in the dorsal posture, with head at *H*.

S. station of surgeon.

I.T. instrument table at surgeon's side.

N. station of nurse or assistant.

A. station of anæsthetist.

A.N.T. table for use of nurse and of anæsthetist; it bears the generator of ether vapor, gauze, etc.

period is to be avoided, also occasions of mental or physical stress such as school examinations and athletic contests. The digestion and other functions should be normalized, as far as possible, preparatory to the operation so that the patient may have the best chance to make a prompt and complete recovery.

Why do we resort to tonsillectomy? Because it is a cure, and the only trustworthy cure, for morbid conditions pregnant with possibilities of evil and because, when performed by a competent specialist, it neither endangers life nor inflicts

permanent injury upon any organ or any function. That hæmophilia and a few other contraindications exist, does not invalidate this assertion because an educated specialist would at once exclude such cases as inoperable. It is curious that some eminent laryngologists have manifested a prejudice against this operation which was all the stronger because it rested on sentimental, rather than scientific grounds. They would consent to mangling the crypts, or to cutting away the cortex, but enucleation, total removal of an organ, which is Mother Nature's handiwork; that seemed to them almost immoral! When a noted London surgeon spoke of the "massacre of the tonsils," he strove to prejudge the question by using a term which always implies condemnation. Other authors have written in the same strain, but sentimental considerations cannot induce the clinical surgeon to spare a mass of diseased tissue which is both useless and dangerous. We kill the venomous cobra whenever we can, despite the teachings of Hindoo philosophy that the snake may harbor the soul of a Rajah.

The final inquiry is how tonsillectomy shall be performed. In so far as the answer relates to the surgeon, it is positive and permits no exception. He must be a well-taught, well-trained, experienced specialist; the operation makes such demands upon both knowledge and skill that no one but an expert should undertake it; nor does it come within the category of those emergencies in which a physician is justified in attempting unfamiliar work because the patient's life depends upon immediate action. In this case the urgency is never so great as to prevent the engagement of a specialist.

There are several methods of tonsillectomy: it is sufficient to describe two. The first is the craft-master's operation, using the simplest instruments and the aid of but two persons, an anæsthetist and a nurse, or other capable assistant. Their stations and the arrangement of the necessary furniture are shown in the schema upon page 219. The positions designated in the following description are those proper in removing the right tonsil; enucleation of the left requires their reversal.

The instruments adapted to this operation are depicted in Fig. 77.

FIG. 77.—Instruments used in tonsillectomy. *A*, Tongue depressor; *B*, Denhart's mouth gag; *C*, Seiler's septum knife; *D*, Tonsil hæmostatic forceps; *E*, Tonsil-seizing forceps; *F*, Smith's tonsil snare; *G*, Tonsil punch.

The patient, having been physiologically prepared for the operation, is placed in the dorsal posture upon a table, pro-

vided with an adjustable head piece, and is covered from the neck downward with a sterile sheet, the hair of the scalp being enveloped in a sterile rubber cap. The surgeon's station is on the left of the patient and within easy reach is his instrument table. The nurse stands on the patient's right side and the anæsthetist at his head; conveniently near to both is a small table bearing the ether bottle, inhaler, picked gauze and the generator of ether vapor used to prolong the anæsthesia. Good illumination is indispensable. Every part of the field of operation should be clearly visible so that every manipulation may be distinctly seen. The acromatic and other advantages of sunlight are counterbalanced by the difficulty in securing direct radiation, the risk of cloudy weather and other drawbacks; so we are forced to rely upon artificial illuminants, among which I prefer Hodson's electric headlight. After anæsthesia has been induced by the inhalation of ether, the head piece of the operating table is let down, so that the patient's pharynx is on a lower level than the glottis, in order that escaping blood may gravitate toward the naso-pharynx, not toward the trachea. It is the assistant's duty to dexterously remove such blood with mops of picked gauze. A mouth gag (Denhart's is good) is then inserted and the ether vapor tube introduced at the right corner of the mouth. The tongue depressor is employed to hold the tongue away from the right side of the faucial arch, bringing the tonsil into plain view.

This is the close of the preparatory stage, and before entering upon the next phase, the surgeon reviews the environment and all the conditions, the state of the patient and attitude of the assistants. This inspection may take only a moment or two; but it is highly important and the surgeon should be assured that everything is right before he takes the next step.

This step is to seize the tonsil and drag it out of its fossa. For this a good instrument is needed. The diseased organ is often indurated, occasionally pultaceous; in the former case a clutching implement is apt to slip off, in the latter to tear its way out. To secure an instrument not liable to either mishap,

I have devised a strongly made, long forceps which is straight, except for a downward curve in the handles. Each blade has a small fenestra and its inner surface is serrated, so that the alternate ridges and grooves fit the grooves and ridges of the companion blade. I have rarely seen these blades slip off or tear out. With such an instrument the tonsil is firmly grasped and

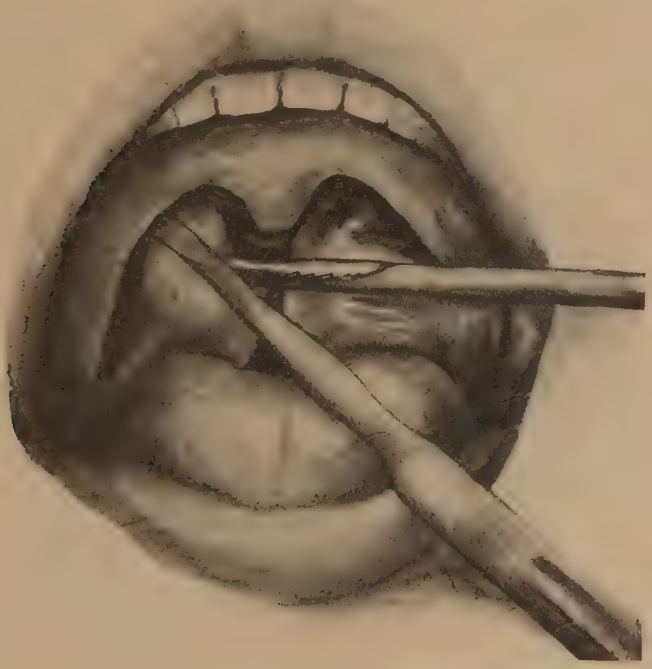


FIG. 78.—First stage in operation of tonsillectomy.

traction made in a line diagonally across the mouth with sufficient force to bring the body out of its fossa and to expose its hidden outlines. While the left hand holds the forceps, the surgeon with his right hand inserts the blade of a Seiler septum knife as close as possible to the tongue, between the tonsil and the anterior pillar of the fauces, keeping the concave surface of the blade in contact with the tonsil. If necessary, the incision is carried through the plica triangularis and is then continued

upward, keeping the blade behind the tonsil, until the supratonsillar lobe is dissected free from the fossa (Fig. 78). At this point the knife is turned, making nearly half of a complete rotation, and then cuts downward, separating the tonsil from the posterior pillar of the fauces and continuing the dissection down to the glossal margin (Fig. 79). The tongue depressor is now

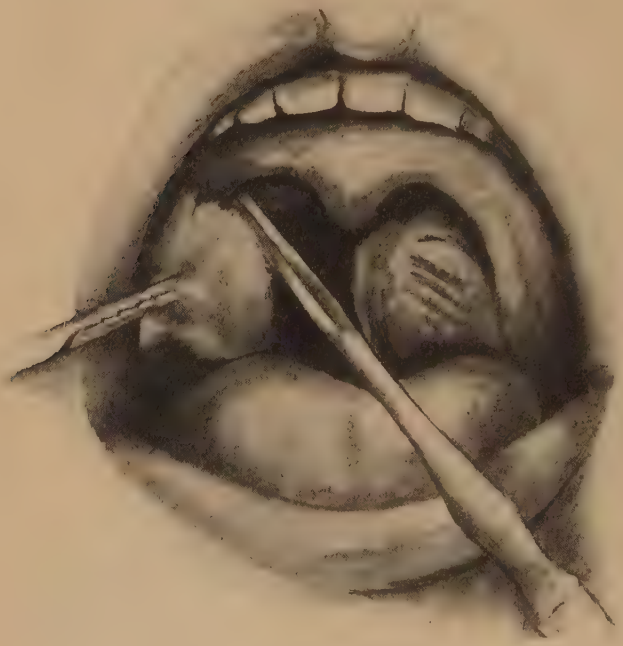


FIG. 79.—Second stage in operation of tonsillectomy.

withdrawn and the right index-finger is introduced into the supratonsillar fossa. Keeping the finger between the tonsillar capsule and the wall of the fossa, with care not to injure the surrounding musculature, any fibers, which have not been cut, are digitally severed, being broken one by one and from above downward. By this process the tonsil should be entirely freed from attachments to the pillars and to the supratonsillar fossa. When such separation has been accomplished, but not till then,

the wire loop of a tonsillar snare is slipped over the handles of the forceps, still in place, and this loop is carefully adjusted to encircle the base of the tonsil where there are still unsevered attachments (Fig. 80). After the loop has been made snug, it is carefully examined at every point to make sure that it includes no part of the faucial pillars or of the uvula. The wire

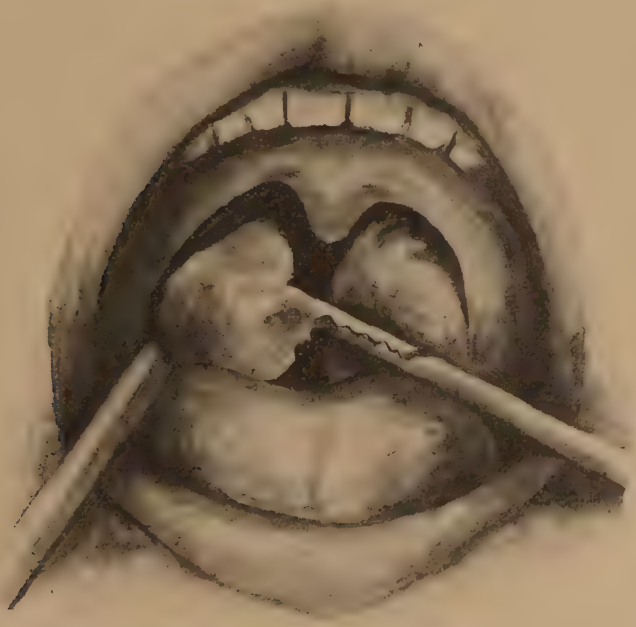


FIG. 80.—Employment of the cold wire snare to complete the enucleation of the tonsil.

is slowly tightened, gradually cutting through the tissues still holding the tonsil and, when they have been entirely dissevered, the surgeon withdraws the forceps, at the same time bringing away the enucleated mass. Fig. 81 shows the appearance of the fauces after removal of the tonsil. Immediately following this procedure, a pledget of picked gauze wrung out of an eight per cent. solution of tannic acid in glycerine is carried by a long curved hæmostat into the tonsillar fossa and packed there.

This will stop all capillary oozing and, if any bleeding still persists, search must be made for the bleeding point and this when found must be ligated. To facilitate finding a bleeding vessel Wood's pillar retractor is useful, though I prefer a delicate double tenaculum with which the anterior pillar is grasped at the junction of its upper and middle third. When the spot is

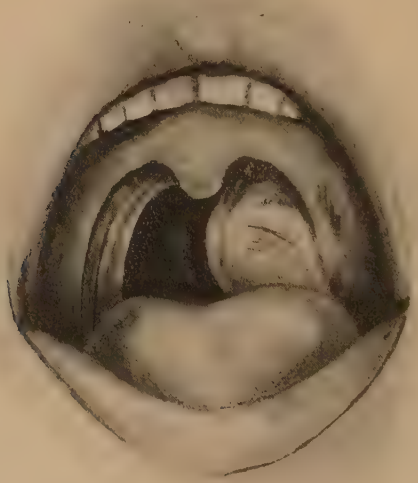


FIG. 81.—Appearance of the fauces after removal of the right tonsil.

found, it is caught up by a long curved hæmostat and encircled by a ligature. An even better plan is to use a small curved needle threaded with catgut of medium size. With this the thread is carried through the adjacent musculature and is tied so as to include the bleeding vessel. After the ligature has been made secure, the ends are cut and the hæmostat removed.

When the surgeon feels assured that there is no danger from hæmorrhage, the packing is finally taken out and the fossa carefully scrutinized to ascertain whether any shreds of the ablated organ remain; if such are discovered they are at once removed

with biting forceps. General anæsthesia is best in this operation but under exceptional circumstances it may be performed by the local application of epinephrin chloride and cocaine, described fully in connection with intranasal operations.

The other method of tonsillectomy which employs the tonsillotome always requires general anæsthesia as local analgesia is not adapted to its technique. Mathieu's tonsillotome is a steel instrument about eight inches long of somewhat complicated construction. Its inventor intended it for tonsillotomy, but it can be utilized for the more radical and satisfactory operation by following the technique hereafter detailed. It is shown in Fig. 82. The mechanism comprises three main portions, the other parts being mechanical devices for transmitting motion. First is the loop designed to engage the tonsil; it is a nearly circular, hollow oval, whose diameter is an inch or more. The second is the ring-shaped knife interposed in the loop, sharp on its inner circumference and cutting by traction toward the operator. The third is a fork with two barbed prongs, which transfix the cortex of the organ and keep it from falling when cut off. To these I have added a fourth feature consisting of a chain with one end riveted close to the loop and the other end

FIG. 82.—Mathieu's tonsillotome; upon one side is the transfixing fork, upon the other the chain and cross-piece.

terminating in an interdigital crosspiece. Traction on this with the surgeon's left hand causes the loop to encircle the tonsil well back from the cortex, avoiding the very common defect of engaging the gland in a shallow, superficial way so that the ring knife pares off only a thin slice. It is necessary, on account of variation in the size of diseased tonsils, to have three of the Mathieu instruments so that one may be used whose loop will just slip over the mass where its circumference is greatest.

In enucleating the right tonsil, the stations of the surgeon and his assistants are those shown in the schema upon a former page. The physiological preparation, induction of anæsthesia, lowering of the head and illumination of the throat, are the same as those described in discussing the first method of operating. The differing technique begins by grasping the tonsillotome with the right hand, the first and second fingers passing through the lateral rings and the thumb through the ring on the fork. At the same time the crosspiece of the chain is grasped by the left hand. The instrument is passed through the mouth obliquely till the distal side of the loop is behind the tonsil in contact with the posterior faucial pillar and the shaft emerges near the left corner; then by traction on the chain combined with oscillation of the shaft the tonsil is brought fairly into the loop and, by further traction on the chain, is dragged forward against the last, lower, molar tooth. This tooth acts in a piston-like manner, pushing the tonsil still further through the loop and helping to hold it there. The thumb of the right hand is now used to propel the fork whose prongs transfix the cortex or the subcortical tissue. By an ingenious device the fork is pushed away from the shaft, at the instant of transfixing, thus still further enlarging the protruding segment, which is kept in place by the fork on one side, by the tooth on the other, and also by the encircling loop steadied by both the shaft and the chain. Assured that all these supports are firm, the surgeon now makes traction with the first and second fingers of his right hand, causing the ring knife to cut through the entire mass engaged within the loop. The instrument is withdrawn, bring-

ing with it the tonsil impaled upon the fork; blood is wiped from the raw surface, remaining shreds of tissue clipped off with biting forceps, and the fossa packed with picked gauze, to be removed when the condition of the denuded tissue gives assurance that there will be no further bleeding. Fig. 83 portrays the tonsillotome in use.

When the left tonsil is to be enucleated, the instrument is introduced so that the distal side of its loop reaches the left

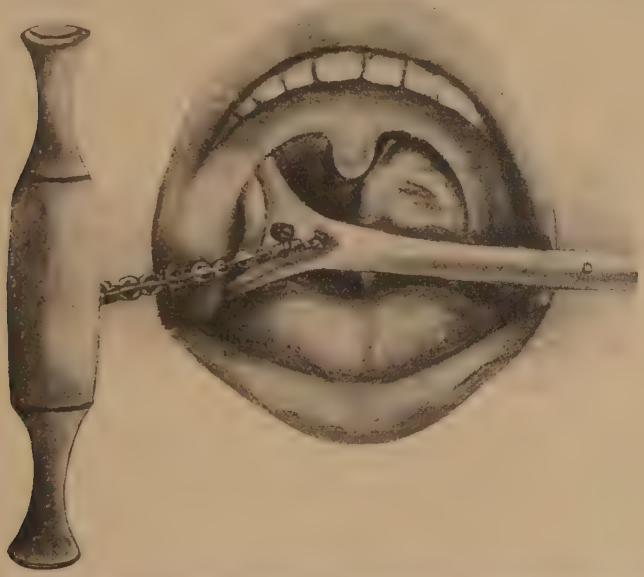


FIG. 83.—Position of the tonsillotome at the moment when the attachments of the tonsil are cut.

posterior, faucial pillar, while its shaft crosses the mouth diagonally, emerging near the right corner. If the surgeon is ambidextrous he pulls the chain with his right hand, manipulating the fork, loop and ring knife with the left. Otherwise, each hand does the same work as in removing the other tonsil. The left hand, by crossing over above the right wrist, comes into a proper position to make traction upon the chain. Other details of the technique in operating upon the left tonsil are the converse of those followed in operating upon the right.

By a little practice, one may learn to successfully employ this method in removing diseased tonsils of many kinds, including those that are softened, those that are indurated, and those buried in very deep fossæ. Almost the only exception is a tonsil too large for inclusion in the loop. Even this may be extirpated by using the largest instrument and by the first incision cutting off a segment from the upper part of the cortex; then by the second taking a similar piece from the lower part, and finally passing the loop over the organ reduced in size and cutting it free from its attachments.

After tonsillectomy by either method, a patient requires the treatment recognized by general consent as proper in the post-operative state. Its main features are rest in bed, freedom from mental and physical exertion, until nervous equilibrium is restored, and a bland, unstimulating diet. Abnormalities in temperature, pulse rate, or indeed in any function, require the attention necessary in such conditions, whatever may be their causation, an elementary matter, with which every physician is familiar. No local treatment is commonly necessary. The raw surface left by the enucleation heals by granulation and subsequent contraction reduces the fossa to a small size. The velum palati, the faucial pillars and all contiguous organs, perform their functions unaffected by the departure of two of their group. There can be no recurrence for the tonsils are absolutely gone and with them the disorders and infections of protean forms with which they were associated.

CHAPTER XX

THE LINGUAL TONSIL

The lingual tonsil is a lymphoid body situated upon the tongue at the median line, slightly posterior to the faucial pillars. It may be examined by direct vision, if the mouth be wide open and the tongue well depressed, and also by reflection in the laryngeal mirror. It presents a slightly elevated, rounded contour with a central fissure, from before backward, caused by the median glosso-epiglottic ligament. Upon its surface are numerous small nodules with flattened or depressed tops, in each of which is the orifice of a duct leading to a mucous gland. These nodules consist of lymph cells, the internodular spaces being filled with connective tissue. The depressions upon the nodules somewhat resemble the crypts or lacunæ of the faucial tonsils and under the influence of inflammation they become filled with a caseous exudate and epithelial débris, which may be so abundant as to cover the interspaces and form patches much like the membranous exudate seen in cryptic tonsillitis (faucial). Branches of the blood vessels of the tongue and a few filaments of sensory nerves ramify through the stroma in conjunction with lymphatics. The function of the lingual tonsil, if a function exists, is unknown. The period of greatest development is infancy and childhood and after puberty there is a tendency to atrophic change, but this is less marked than in the other lymphoid bodies and, in many persons, both size and vascularity continue unchanged till middle life.

The lingual tonsil often participates in the inflammatory processes affecting other parts of the throat and, quite aside from any purpose of ours, comes in for its share in the effects of sprays, lozenges and other therapeutic measures, but only two conditions are likely to make it the primary object of treatment

—varicose veins and hypertrophy. The cause of varix in this locality is conjectural and has no demonstrable connection with the disease in other parts of the body; a long-accepted, popular opinion associates it with overexertion, or misuse of the vocal organs. Visual inspection shows the surface of the tonsil traversed by enlarged blue veins more or less tortuous; to the finger they give the sensation of a compressible body, slightly elastic; they are not tender under pressure. Sometimes varix exists for a long time, without giving rise to any symptoms, being discovered during an examination of the throat having some other object in view. When symptoms are present the patient complains of pain, which is aggravated by using the voice and alleviated by eating; a curious fact as yet unexplained. The pain frequently gives the impression that a foreign body is lodged in the fauces, pricking and scratching the mucous membrane.

The purpose of treatment is twofold: to stop hæmorrhage when, in some way, one of the veins has been eroded and there ensues considerable bleeding; and to effect a radical cure by extirpation of the varix. The bleeding can nearly always be effectively arrested by a mixture of equal parts of the tincture of chloride of iron and glycerine, topically used with a cotton-tipped applicator, or a bead of fused chromic acid lightly drawn over the surface after desensitization with an eight per cent. solution of cocaine. This is a temporary, palliative measure to meet the emergency of such loss of blood as may alarm the patient or his friends, though dangerous hæmorrhage at this spot is rare. Recurrence of the bleeding should be rendered impossible and annoying symptoms abolished by the radical operation. The best method is to induce local anæsthesia with an eight per cent. solution of cocaine and then to draw transverse lines over the engorged veins with the electrode of the galvanocautery. The temperature must be that signified by the cherry-red color of the metal; if a white heat is used, there is no hæmostatic effect, and indeed, it may cause profuse hæmorrhage.

After the extirpation, the patient is apt to suffer considerable pain at intervals until the surface under the eschar is entirely healed. This pain is felt particularly when food passes over the tonsil on its way to the œsophagus, hence the diet must be of the blandest description, entirely free from spices and other pungent ingredients. I have had good results from a lozenge containing one-fifteenth of a grain of cocaine hydrochlorate. A short time before a meal the patient puts this lozenge on his tongue and allows it to dissolve slowly, taking no food until the solution is complete. The partial anæsthesia produced greatly mitigates the pain and prevents the dread which in sensitive persons nearly destroys normal appetite and proves a hindrance to normal digestion.

Fig. 84.—Hypertrophied lingual tonsil in a case of leukæmia.

The lingual tonsil, like others of the group, is liable to hypertrophy, here as elsewhere characterized by proliferation of the cellular elements and hyperplasia of the connective tissue. As a palliative treatment, equal parts of tincture of iron chloride and glycerine may be used with a cotton-tipped applicator. Extirpation may be performed under anæsthesia induced by an eight per cent. solution of cocaine. The wire snare can seldom be employed with advantage because the tonsil's shape furnishes little chance to encircle it properly with the loop. It may be grasped by Volsella forceps, or by my faucial tonsil forceps, raised as much as possible from the tongue and its basal attachments severed with a pair of curved scissors, or with a bistoury.

When this method is not available, the tonsil may be exsiccated by the galvanocautery (cherry-red heat) and allowed to remain in place until it is underlaid by granulation tissue and is cast off as a dry, devitalized crust. Postoperative treatment, after removal of the tonsil, is the same as that pursued after extirpation of a varix. Fig. 84 represents a greatly hypertrophied lingual tonsil in a patient suffering from leukæmia.

CHAPTER XXI

THE LARYNX: FORM AND FUNCTION

The larynx is situated upon the boundary between the throat and the chest. In traversing it, the breath-road leaves the cervical region and enters the thorax, so too the food-road in descending beyond this plane passes into the œsophagus and hence into the stomach, the remainder of its course being abdominal and pelvic. It is commonly said that the plane of the larynx divides the field of the surgeon from that of the internalist, to whose province belongs the treatment of thoracic and abdominal organs. The distinction is convenient, but in strict accuracy there remains no region of the body from which surgery is debarred. When the walls of the beating heart are sutured with safety and success, the knife and the needle may go anywhere.[1] With few exceptions, the ancient surgery was restricted to the surface; but mechanical penetration has gone deeper and deeper till, to the great honor of laryngology, Killian and Chevalier Jackson have discovered foreign bodies in the center of the lung and have removed them by way of the bronchi with entire success.

[1] It is a notable fact that the limits of surgery remained almost unchanged from the first century to the sixteenth and that the extraordinary enlargement since then has been due to three discoveries representing three countries: France, Scotland and the United States. First came the Frenchman, Ambroise Paré. Early in the sixteenth century, when kings and princes seemed bent on depopulating Europe, he introduced the ligation of arteries, saving countless lives and revolutionizing the treatment of gun-shot wounds. In the nineteenth century Lord Lister of Edinburgh brought in antisepsis, leading up to our present practice of sterilization, and Dr. Morton of Hartford (1846) discovered anæsthesia. The work of this trio, by either its direct or remote influence, has made every region of the human body accessible to surgery and now it seems probable that Dr. Crile of Cleveland, by eliminating the dangers of shock, will immensely increase the advantages attendant upon capital operations and add a fourth name to this group of the world's benefactors.

In shape the larynx somewhat resembles the upper part of a cylindroid pitcher, with a wide spout (Adam's apple) in front, covered by a lid, the epiglottis, hinged to the spout, and having its interior cavity open at the bottom. Fig. 85 represents the anatomical framework of the organ divested of the membranes covering its surface, viewed from the rear. The laryngeal framework is very complex, no less than nine cartilages taking part in

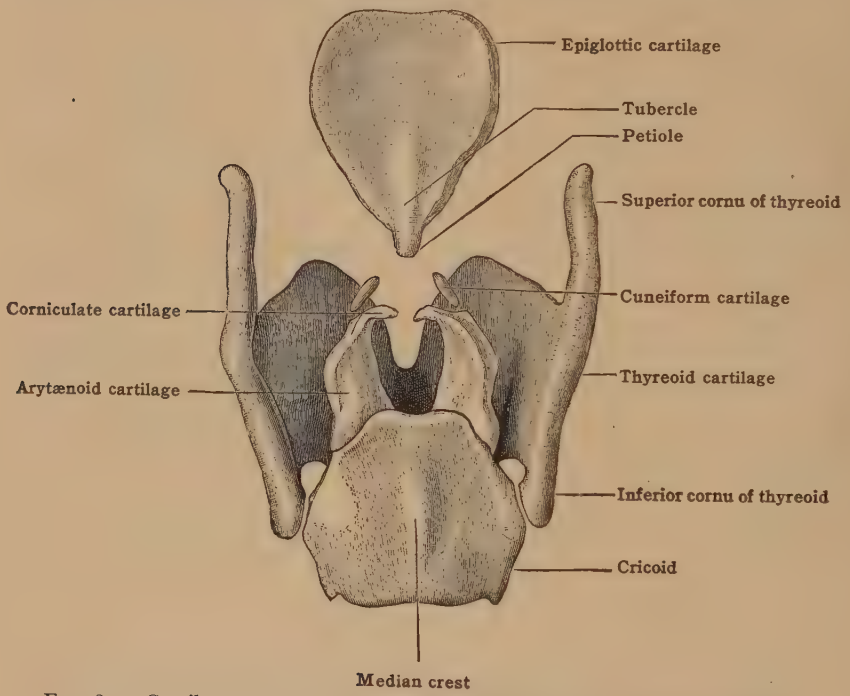


FIG. 85.—Cartilages of the larynx seen from behind in their natural positions. The cuneiform cartilages are somewhat higher than normal. (*Merkel.*)

its composition. They are the thyroid, cricoid and epiglottis, which are single, and three occurring in symmetrical pairs; the arytenoids, cuneiformæ (cartilages of Wrisberg) and cornicula laryngis (cartilages of Santorini). These together with their articulations, the ligaments attached to them and the interior and exterior muscles, some of which are shown in Fig. 86, render the structure of the organ especially complicated. Most of

this complexity, however, becomes evident only upon post-mortem dissection. The living, functionating larynx, the larynx with which we deal, presents itself as a single structure; its numerous parts are firmly joined into one whole; an organ which is firm, but not rigid, which possesses some flexibility and elasticity. Its outside surface gives attachment to a number of muscles which move the organ as a whole and which, in conjunction with the intrinsic muscles, alter the relative positions of the component cartilages and ligaments. Its interior is lined throughout with mucous membrane, having near the upper margin a squamous epithelium, but at the level of the vocal cords and upon the surface below them a columnar, ciliated epithelium. At the junction of the larynx with the trachea the shape of its internal cavity is cylindrical and this form is maintained till above the middle, where the space is lessened and altered from a circular form to a rectilinear shape which, where most widely extended, is almost a triangle with its apex in front near the root of the tongue, and its base in the rear near the œsophagus. This is not only the most contracted part of the laryngeal tube, but the smallest opening through which the breath-road passes in its entire course.

FIG. 86.—Posterior view of important muscles of the larynx and part of the cartilages. The thyroid cartilage has been removed. *A*, epiglottis; *B*, aryteno-epiglottidean muscle; *C*, arytenoid cartilage; *D*, arytenoid muscle; *E*, remaining border of thyroid cartilage; *F*, posterior crico-arytenoid muscle; *G*, trachea unopened.

This orifice, called the glottis, or rima glottidis, is in the adult male about an inch long and half an inch broad, at its widest point; in females both the length and breadth are less. Its size and shape are regulated by the two lower thyro-arytenoid ligaments, which encroach upon the intralaryngeal space from the right and left; when they are furthest apart, the aperture

between them is trianguloid; when they approach each other closely, it becomes a mere slit, which is extremely narrow. These thyro-arytenoid ligaments are the true vocal cords, the chief organs of the voice. Each one consists of a single, strong band of elastic, fibrous tissue, attached in front to the thyroid cartilage and behind to the arytenoid: the band is covered by mucous membrane, very thin and very firmly adherent. By enveloping this fibrous strand the mucosa forms a narrow ribbon of two layers, each of which is reflected over the contiguous surface, one above and one below, thus becoming continuous with the mucosa, which lines the inner surface of the laryngeal walls. The result is that the ribbon of folded mucous membrane is attached along its outer margin to the walls of the larynx, while its inner margin is free and movable; this free inner margin envelops the fibrous strand or cord, which is thus capable of vibratory movement and can be relaxed or made tense. The entire ribbon-like structure, including the elastic, fibrous band and the overlying mucous membrane, is commonly designated the vocal cord. Our usual concept of a cord is that of a strand or string, fastened at the extremities, but otherwise unattached and free to vibrate by curving in any direction. A vocal cord does not comport with this description; it is not a free string, but a membrane with one free margin or border and this border can vibrate up and down; but only in these directions, as inspiration curves the border downward and expiration curves it upward. The band's elasticity causes its resumption of its habitual position, after each impulsion in either direction. Situated a little above the vocal cords and separated from them by two narrow fossæ, called the ventricles of the larynx, are two longitudinal folds of mucous membrane, termed the false vocal cords because, while resembling those just described in some particulars, they do not take part in producing the voice, though they may have a modifying influence. Fig. 87 gives the image of the larynx seen in the laryngeal mirror.

The larynx has two functions: respiration and phonation. In respect to the first, it serves as one section of the breath-road,

connecting the passageway of the pharynx with that of the trachea, and this section has peculiar characteristics due to the fact that the glottis is the smallest orifice through which air

FIG. 87.—An entirely normal larynx, as reflected in the laryngoscope. *A*, left arytenoid cartilage; *C*, left vocal cord; *E*, epiglottis. Observe that these structures upon the left side of the throat appear on the right side of the reflected image. Such lateral reversal always occurs in a mirror. Remembrance of this fact will prevent the confusion so common in illustrations of the larynx and of other organs seen in reflected images.

currents pass. This has much clinical importance; for at this point there is great liability to obstruction, either by the lodgement of foreign bodies, or by obstacles produced in the course

of disease. If the larynx is occluded, there is no collateral route for the passage of air, such as the mouth supplies when there is closure of the nares, and fatal suffocation can be prevented only by opening an artificial route, as is done in tracheotomy; or by some other expedient, which will bring oxygen to the lungs.

The older physiologists were not far from the truth in designating the larynx as *the* organ of voice; for the part it plays is preëminent, while that of the various chambers, resonating

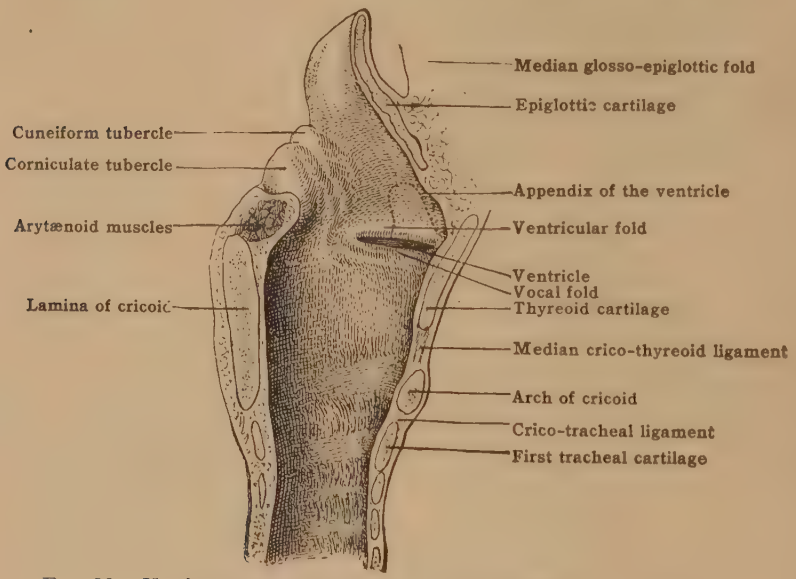


FIG. 88.—Vertical section of the larynx in the median line. (*Merkel.*)

cavities, is wholly subordinate. Remember we are considering voice, not articulate speech. Many organs between the larynx and the lips coöperate in making sound articulate; that is, in converting voice into speech; but the production of voice itself is primarily and chiefly the function of the glottis and vocal cords and a few contiguous structures which are portrayed in Fig. 88, representing the left half of the organ displayed by a vertical division along the median line.

The preëminence of the larynx in producing the voice has long been well known; but even today there are many who hold the belief, anciently prevalent in most countries, that the tongue is the chief organ of phonation, a belief expressed by using the same word for the organ and for the language; as we say: teaching the English tongue, translated into the English tongue. The same connection of thought is shown in Greek, Latin, Italian, Spanish and many other languages. As a matter of fact, the tongue takes no part in the production of voice, though it aids in articulation.

The mechanism of phonation is similar to that of reed instruments, in which a thin lamina is put in vibration by a current of air. When the vocal cords are fully relaxed and the glottis is open to its full capacity, the air in both inspiration and expiration passes through the larynx, without producing any sound; but when these conditions are changed by muscular action, sounds are produced and their pitch and volume depend upon the character of the muscular contractions. There are eight objects in the actions of the laryngeal musculature: to lengthen the vocal cords, to shorten them, to relax them, to render them tense, to elongate the glottis, to shorten it, to narrow and to widen it. A ninth action pertains to the thoracic and abdominal muscles, which, bellows-like, impel the current of air passing upward through the larynx. These nine muscular acts are capable of a very large number of combinations and it is by their interaction and coördination that the widely varied phenomena of phonation are produced. It is true that there exists a likeness between the mechanism of the vocal organs and the mechanical construction of musical instruments with vibrating reeds; but it is not true, as often asserted, that such instruments were made in imitation of the human larynx; for those of the type whose similarity is greatest were in use long before the physiology of vocalization was understood.

The tones as produced by the vocal cords are modified by harmonics, or overtones, added by the vault of the naso-pharynx, roof of the mouth and nasal sinuses. If these resonating cham-

bers are obstructed by hypertrophies or neoplasms, the voice takes on a rasping, harsh, or muffled quality but the number of octaves within its compass is but little affected. This compass, or register, depends upon the vocal cords and is the same for boys and girls before puberty but at that age the larynx in the male greatly increases in size, the cords are elongated and the pitch of the voice becomes much lower, producing what are called the bass tones. In the female, puberty has little influence upon the pitch and hence opera, oratorio and choir singers are usually chosen from both sexes, the soprano and alto parts being taken by women, and the tenor, baritone and bass by men. There is, however, a certain quality in the voices of young boys which is found in no others; this quality is highly prized by some eminent musical conductors and hence boy choruses are maintained in spite of the inconvenience and trouble entailed by the fact that the singers are constantly changing, the first sign of puberty compelling their retirement.[1] Much has been said of the difference between the singing and speaking voices, but their method of production is the same and the most valid distinction is that, in speaking, far more attention is given to distinctness of articulation and little use is made of either very low or very high tones, while, in singing, the creation of these tones at the upper and lower extremities of the register is greatly valued, as is also great clearness and accuracy in the production of each note.

The gift of voice is restricted to a small part of creation. The whole inanimate world is mute, so also is the vegetable kingdom and all of the animal kingdom below the vertebrates; even among the vertebrates the almost numberless fishes and most of the reptiles are voiceless. The birds and mammals have phonation, but within very narrow limits, for even the most intelligent of the lower animals, like the dog, can utter but few sounds. In contrast with the wonderfully varied effects of

[1] In some churches the choirs are composed exclusively of men and boys, because the highest ecclesiastical authority forbids the participation of women in the musical service. This was the general church custom down to the sixteenth century.

which the human voice is capable, the dog's vocalization is extremely slight and indicates the wide gulf that separates him from man. Phonation also shows the solidarity of the human race, for the degraded Melanesians of the south Pacific have vocal capabilities that differ but little from those observed among civilized peoples of the highest type. One thing the domesticated dog has learned in his long association with man, he can bark, while his wild relatives, the hunden of South Africa and the jungle dogs of India have only howls, yelps, and growls. This solitary acquisition by the most intelligent of brutes is almost pathetic in its proof that he cannot pass the chasm separating him from man whose companion he has been through the ages. The man-reared dog had learned to bark three thousand years ago and has learned nothing more since that time.

CHAPTER XXII

LARYNGITIS

Acute laryngitis may occur as a primary affection, but it is much more commonly secondary to inflammations of the pharynx and intranasal canals; these are the chief predisposing causes. Among others, is the overexertion of the voice or faulty methods in its use, a sedentary life passed in rooms poorly ventilated and indigestion, either gastric or intestinal. Many text books add the rheumatic diathesis, and this constitutional condition is, without doubt, often present in those subject to laryngitis and other throat troubles, but it is questionable whether the so-called diathesis bears a causal relation to the laryngeal affection. Perhaps both are merely synchronous and owe their origin to a common cause.

Simple laryngitis is most common in children and young adults, and affects nearly an equal number of males and females. Its exciting causes include sudden vocal strain, like that produced by oratorical efforts in the open air by one unaccustomed to loud speaking out of doors, a very common experience of candidates in political campaigns; also the inhalation of irritant particles of dust and smoke and noxious fumes given off in dye-houses and manufactories of chemicals. By far the most common exciting cause, at least in the estimation of the patients themselves, is the incident called "catching cold," an experience familiar to almost every one who lives in a changeable climate, subject to sudden variations in temperature and barometric pressure. As has been said already, the quick disturbance of the balance between the pressure within the body and without, causes an increased flow of blood to the mucosa, the thinnest partition separating the inside and outside, with consequent congestion, perhaps inflammation. These phenomena, when

they occur near the glottis, are specially serious, because of the narrowness of the space, due to which any swelling following engorgement must extend in the direction of the center, where there is little room to spare.

Usually the first symptom noticed is a change in the voice which is hoarse, muffled or squeaky; in some instances the function is suddenly suspended, as when the patient, on rising in the morning, finds he cannot make himself heard, the changes causing loss of voice having occurred during his sleep. In addition to this, there is some soreness in the laryngeal region and the front of the throat may be tender under pressure. Soon a cough develops; at first short and dry in quality, later becoming prolonged and moist. Expectoration soon appears, beginning with watery mucus, scanty in amount, but later becoming free, thick and purulent, if the inflammation is sufficiently severe and extensive to attract many leukocytes to the part. The laryngoscope shows the mucous membrane generally to be congested and of a deeper red than normal; the covering of the vocal cords, which is very thin and usually pale in color, may acquire the crimson tint of the contiguous structures, though this change does not always occur. Often the cords are swollen and there may be edematous enlargement in the membrane just below their attachment, an enlargement that can be seen through the orifice of the glottis. This is of serious import, as the narrow passageway may readily be occluded.

Constitutional symptoms may be absent, or there may be malaise, thirst, anorexia and the other phenomena associated with slight pyrexia.

In treatment, the indispensable factor is rest for the vocal organs. The use of the voice must, for the time, be forbidden. No exception can be made for whispering, although there is prevalent a fallacious belief that it is harmless; on the contrary, the muscular contractions required by loud phonation are also needed to produce the whisper, in which the volume or intensity of sound is very slight, but nevertheless the escaping air has been phonated before it reaches the organs of articulation,

otherwise no sound whatever would be heard; the phonogenetic vibrations are required in the whisper and to produce them tires the muscles and is incompatible with the absolute rest which is needed. The patient should be confined to a well-ventilated room whose temperature is uniformly kept at 72° F. and whose atmosphere is rendered moist by steam. He should have a plain, nonstimulating diet, with an abundance of water and also fresh milk, unless that proves unsuitable, as it does with some adults, though always available for children. Alcohol, tobacco, coffee and tea are prohibited. Chocolate and cocoa may be used, as also orange juice and lemonade—a concession to the taste of persons who are habituated to drinks other than plain water. Full and free action of the bowels is to be secured by small doses of calomel given at short intervals and followed by a saline cathartic. To promote secretion and relieve the cough, I advise the following sedative expectorant:

℞. Codeine sulphate..... gr. iij
Antimon. et potas. tart..... gr. ij
Liq. potas. citrat.....q.s. ad. fl. ℥iij. M.
S. Take a teaspoonful every two hours.

Inhalations of vapors prove serviceable, particularly that of benzoin. To one-third of a pint of water at the ordinary temperature, add two-thirds of a pint of boiling water and a fluid-drachm of the compound tincture of benzoin; over the top of the jar or other vessel holding this mixture, adjust a funnel made from a folded towel which will convey the medicated vapor to the upper respiratory tract.

During the first stage, it is beneficial to spray the nose and fauces with Dobell's solution. After secretion is well established, it is well to employ stimulating expectorants, such as ammonium chloride gr. v, combined with codeine or with Dover's powder. At this stage also, there is advantage in applying astringent sprays directly to the larynx by means of an atomizer with a curved tube guided to the proper position by the image in the laryngeal mirror. A good solution for this purpose is made by dissolving from three to five grains of zinc sulphate

in a fluidounce of sterilized water. Under such treatment, recovery generally takes place, without leaving any permanent injury to the voice or any other function. Some persons are prone to recurrent attacks and examination usually shows that they have abnormal conditions in the nose, pharynx, or tonsils acting as permanent predisposing causes. These abnormalities should be dealt with in a thoroughgoing way and it will be found that their correction puts an end to the repeated attacks of laryngitis.

Spasmodic or night croup, also called false croup, to distinguish it from the pseudomembranous variety, seldom comes under the care of a specialist, because the attacks occur suddenly in children previously in their ordinary state of health and exclusively at night. Where a close watch has been kept, it has been found that during the preceding twenty-four hours there are some prodromes, such as a slight rise in temperature and acceleration of the pulse rate with restlessness and general discomfort, but in the great majority of cases these things are overlooked. The child goes to bed at its usual time and falls into a deep, heavy sleep; at midnight or in the early morning hours, it suddenly starts up with a cry of terror and begins to struggle for breath, catching at its throat and swaying from side to side, while its eyes are wide open and staring and its lips and nostrils have the cyanosed tint of suffocation. The distress of the little patient is extreme; there is the sense of strangulation and, in those old enough to reflect, the dread of impending death. Many a gray-haired man vividly recalls the terror and anguish of those attacks and avers that, among all the multiform pains of fifty years, none have been worse than these sufferings of childhood. The pathology of false croup is the same as of simple, catarrhal laryngitis, with the addition of a neurotic element causing the muscular spasm by which the glottis is closed, giving rise to the torturing suffocation.

A fatal termination is rare, because spontaneous relaxation occurs as carbon dioxide accumulates in the lungs. Of course, we do not wait for this with the suffering and other evils delay

entails. To relax the spasm by treatment is the first object in view and an admirable remedy, is a few minims of chloroform dropped upon a handkerchief and inhaled. It is a thoroughly safe remedy and the relief it gives is often magical. Though it has no effect on the inflammatory process in the larynx, it secures at least a partial relaxation of the suffocating spasm and greatly lessens the child's distress while other measures of treatment are in preparation. For thorough relaxing and alterative effects the hot bath proves very efficient. The comfort it gives is so great that the child is apt to fall asleep in the water. If facilities for the bath are not at hand, sponges or towels steeped in hot water may be applied to the throat with good, though minor effects. Emetics are also valuable, for the revulsive influence of vomiting produces muscular relaxation and in addition, the stomach is emptied of food which has remained there for many hours only partially digested. The emesis often, not always, brings to light a condition of gastric indigestion which had not been suspected, but which doubtless played a part in provoking the attack of croup. Ipecac, in the form of either the syrup or wine, should be administered in doses of one or two teaspoonfuls, according to the age of the patient. It is one of the most trustworthy emetics and also quite safe, as its action terminates with the expulsion of the gastric contents. There are no depressing constitutional effects.

After convalescence from the acute attack, attention should be given to prevent recurrence. For this purpose the following mixture is useful:

℞. Tinc. aconiti rad. ..... ♏xxiv
Potas. citratis ..... ʒj
Potas. bromidi ..... gr. xl
Syr. ipecac ..... fl. ʒj
Syr. limonis ..... fl. ʒj
Aquæ ..... q.s. ad. fl. ʒiij. M.

This may be administered every two hours in doses adapted to the child's age; a teaspoonful is suitable at two years. Hygienic measures also are of importance. The physician should

look into the child's diet, habits and manner of life. He will probably find a number of things which need correction, and if the parents are wise enough to follow his advice and adapt their child's environment to its age, strength and mental and physical qualities, it is likely to have but few attacks of croup or, indeed, of any other illness.

Œdematous laryngitis is characterized by an engorgement occurring beneath the mucosa, especially where it is loosely attached to the submucous structures, as in the ventricle of the larynx. The fluid producing this engorgement is mainly serum with an admixture, greater or less, of the other constituents of the blood, and the color of the œdematous surface is pale or red, in proportion to this admixture. In the laryngeal mirror the vocal cords appear swollen, encroaching upon the orifice of the glottis; sometimes the œdema is most marked in the tissues above the cords, sometimes in those below, sometimes in the strands themselves. In all cases the effect is to diminish the size of the glottis. The voice is husky, muffled, or perhaps wholly suppressed, there is a harsh, short cough and more or less pain, but the symptom which predominates, both in the sensations of the patient and in its clinical significance, is the dyspnœa due to the impaired respiration. For the time being, other things are insignificant, as the patient's life depends on keeping open the breath-road or, if it is closed, on creating some substitute passageway.

Why certain cases of laryngitis should develop œdema of the glottis, while the majority pass through all their stages without producing it, has been a debated question and various explanatory theories have been brought forward, but they are conjectural and of little value to the clinician.

Treatment has three objects: first, to deport the accumulated fluid; that failing, to evacuate it and, if respiration be still seriously embarrassed, to maintain a breathing route, in spite of it. The first procedure is successful in certain mild cases where the swelling is moderate and stationary; it includes reduction of the somatic content of serum by active purging with

cathartics which produce large, watery stools, such as Epsom salts, together with the induction of topical ischæmia by putting an ice bag upon the throat over the larynx, holding ice fragments in the mouth and applying epinephrin chloride (solution of 1 : 1000) to the œdematous membranes either by the spray from an atomizer or with a cotton-tipped probang, directed by the laryngeal mirror. The second procedure resorted to, provided success does not attend the measures mentioned, is free scarification with a lance blade attached to a curved shank and guided by the mirror. The serum, blood, liquid of any kind which distends the membranes is to be evacuated and ejected from the mouth, caution being observed to keep the trachea free from it. If such treatment proves unsuccessful, or without resorting to it in fulminating cases, where the symptoms of asphyxia grow rapidly more and more threatening, the third procedure is demanded; the last resort, making a substitute route for respiration, so that it can be maintained irrespective of the occluded glottis. This final resort is tracheotomy and many surgeons turn to it reluctantly, both because of its inherent difficulties and because this artificial passageway delivers the air to the lungs in a state liable to cause serious trouble, since it has not had the preparation it receives when normally taken through the nose and pharynx. Nevertheless, if tracheotomy appears to be necessary, there should be no loitering; the patient's chances grow momentarily less if the oxygenation of his blood is hindered, and action should closely follow decision. It is a wholly mistaken conservatism which delays a necessary operation until the patient is moribund.

Chronic laryngitis has two varieties: the catarrhal and the atrophic. The first is commonly a prolongation of the acute form and exhibits that abatement in the symptoms and physical signs which is observed in so many morbid states, when there has come about a sort of compromise between the malady and the organism. The body establishes some tolerance of the disease and the mind adapts itself to the abnormal conditions, so that the patient learns to live and work with some functions

crippled. In the category of causes of the chronic variety, in addition to repeated and inefficiently treated acute attacks, are abnormal conditions in the nose, fauces and naso-pharynx, especially adenoids with the consequent mouth breathing, and also continued misuse of the voice.

The symptoms are a feeling of constriction and dryness, a dry hacking cough with scanty expectoration of white, stringy muco-pus. The voice is hoarse, trembling and easily fatigued. Usually there is no dispnœa or dysphagia. The laryngoscope shows the mucous membrane to be in a state of sub-acute inflammation with punctuated irregularities of surface, enlarged glands and many abrasions, particularly in the interarytenoid spaces. Actual ulceration is exceptional, a diagnostic point in differentiating this catarrhal type from the forms due to infections.

Treatment is primarily influenced by the etiology of the affection. It is indispensable to correct abnormalities in the nose, naso-pharynx and fauces which play such a mischievous part in all diseases affecting the breath-road. So too the disorders of metabolism, whether indicated by dyspepsia, constipation or any other form of indigestion, must have careful investigation and appropriate treatment; for unless the nutritive functions are properly performed, special organs cannot be maintained in a normal state, much less restored after illness. As to the rheumatic and gouty diatheses, so called, which are manifested by arthritis and the varied myalgias, it matters little in our therapeutics whether these dyscrasias are causal or only coincident; it is plain that they point to morbid constitutional conditions which aggravate the throat disorder and, if they are corrected by appropriate treatment, the throat will be benefited. The voice must have rest until there is improvement in its quality, and the faulty method of using it, which is a frequent etiological factor, should be supplanted by a proper phonation. In some instances excellent results have followed a vocal training corrective of former mistakes, the method being devised by the physician and teacher in coöpera-

tion. Where the patient's occupation exposes him to smoke, dust, or irritating vapors, a change in vocation may be necessary to a cure. Alcohol and tobacco are to be avoided and the best hygienic conditions available should be maintained.

In addition to the foregoing measures intended to eliminate the predisposing causes, topical treatment of an alterative kind has much value in counteracting the damage done by the inflammation and restoring the functional activity of the organ. Dobell's solution should be employed for the thorough cleansing of the entire respiratory tract above the plane of the larynx, and should be used by the patient, in the intervals of office visits, to remove secretions and any impurities left by the inspired air. After the membranes have thus been cleaned of extraneous matter, a spray may be directed upon the vocal cords by an atomizer tube of downward curve, guided by the mirror. The solution for this purpose consists of two to five grains of either zinc sulphate, or zinc sulphocarbolate to the fluidounce of sterilized water. To secure healing of the abrasions, which are a prominent feature, it is often necessary to use astringents of greater power, and I find the zinc salts just mentioned efficient if the strength of the solutions is increased, making them ten grains to the fluidounce. When the abrasions are persistent and the zinc salts are tardy in action, as sometimes occurs, I recommend the application of a two per cent. solution of silver nitrate. These stronger remedies must be used with a cotton-tipped, laryngeal applicator, moist but never dripping. With the silver salt, especially, care must be taken that none of the solution drops down into the trachea. Stimulating expectorants are adjuvants to these topical measures. Lozenges of ammonium chloride, each containing two grains, or of ammonium iodide containing one grain, answer the purpose and five or six may be allowed to dissolve in the mouth during the course of a day. The progress of a patient toward recovery is sometimes interrupted by an exacerbation of the disease which, without any assignable cause, suddenly shows a recrudescence of acute symptoms. Under such circumstances, we must suspend, for the

time being, the stimulating treatment and recur to the sedative therapeusis appropriate in an acute attack. An incident like this is apt to discourage the patient who fears that the improvement has been counteracted and that he is thrown back to the worst stage of the disease, but his mind may be set at rest for these recrudescences soon yield to treatment; the gains made are found to be permanent, and the progress toward recovery is soon resumed.

The atrophic variety of laryngitis is generally secondary to atrophic changes in the nose or pharynx; when these are present the morbid conditions in the three localities must be considered together. The pathologic findings indicate that the mucous membrane has undergone a retrograde change. The ciliated, columnar epithelium gives place to one of squamous type; the mucous glands grow few, or disappear; the blood vessels are contracted and, in consequence, the secretions are of lessened amount and denser consistency so that they dry into crusts whose color is gray, brown, and occasionally nearly black. All the tissues affected show a tendency to dessication and from this circumstance the disease has been called laryngitis sicca.

A very frequent symptom is a pricking, burning sensation, following the use of the voice, especially if there has been an effort to produce tones of large volume, or high pitch. A hoarse, spasmodic cough is incited by the crusts and the futile efforts to dislodge them. These crusts may encroach upon the glottis, particularly during the hours of sleep, and the patient be awakened by suffocative symptoms which resemble those of spasmodic croup. The laryngeal mirror shows the mucosa to be pale and shrunken, while the vocal cords appear wrinkled; in addition to the crusts, there may be some ulcers in a state of active purulency, chiefly located near the posterior margin.

Treatment follows the general course laid down in discussing atrophic rhinitis (Chapter VII) and often includes it, as the two disorders may be simultaneously present. Locally, Dobell's solution should be applied to the larynx by a spray or a probang, so as to remove all crusts and thoroughly cleanse the

affected surface. The next step is to produce such an alterative effect that the retrograde changes will be stopped and as much restoration as possible secured in those structures, which have begun to shrink. Here, as in other localities, our best remedy is iodine, and for laryngeal use it is preferably administered in the form of nosophen (tetraiodophenolphthalein). The following mixture can be employed either as a spray, or with a swab:

℞. Nosophen..... gr. ii
Menthol..... gr. iii
Olei Olivæ..... fl. ℥j. M.

If ulcers are found, they should be touched with a two per cent. solution of silver nitrate, applied with the precautions already emphasized.

CHAPTER XXIII

LARYNGEAL INFECTIONS

There are three infectious diseases whose pathogenic germs frequently invade the larynx, coming either from the inspired air or through the blood, and which either directly, or by their toxins, originate morbid processes of a distinctive kind and of serious import. These are tuberculosis, syphilis and diphtheria. Laryngeal manifestations observed in the other contagious fevers are symptomatic of the constitutional disorder and rarely produce any throat lesion of importance.

FIG. 89.—Tuberculosis of the larynx; image in the mirror. The right vocal cord is hidden by swelling in or above the ventricle on that side. (*Taylor.*)

Laryngeal tuberculosis (Fig. 89) also termed consumption of the throat and laryngeal phthisis, is sometimes primary, but much oftener secondary to the pulmonary variety; that is to say, the pathognomonic growth, tubercle, does not appear in the throat until a considerable time after it is well established in the lungs. This fact may be interpreted in different ways. Many think that the toxin existing abundantly in the infiltrated pulmonary tissue spreads to the larynx by continuity of surface, by the blood and lymph circulation, or by the current of expired air. This theory requires us to accept two improbable suppositions: first, that the myriad bacilli, borne on the inspired air, proceed directly to the lungs, *via* the trachea and bronchi, none of them breaking their journey at the larynx through which all must pass; second, that with so many avenues available for

spreading the infection from its pulmonary focus, the larynx usually remains uninvaded until a comparatively late stage of the disease so that the supervention of throat phthisis is an ominous prognostic. The observed sequences in the chest and throat symptoms are explained more logically by presuming that many of the immigrating germs do stop in the larynx, but fail to effect a lodgment because the mucosa underlaid by vascular cartilage is a resistant structure, able to repel them. So, too, there is repulsion against microbes carried by the expired air and there is antagonism to the toxins sent forth from the focus in the lung. The larynx is like a fortified castle, holding out against an enemy who has subjugated much of the surrounding territory. When at last, by the weakening of the vital powers, resistance begins to slacken, then the hostile germs and their toxins gain a foothold in the larynx and the progress of disease is often rapid. I offer this theory because it avoids two improbable suppositions and also because it accounts for the minority of cases in which the laryngeal affection is primary, cases otherwise quite unexplained. In these instances the germs find a lodgment in the larynx at the very start, prior to any pulmonary infiltration, because the resistant power of the organ has, in some way, been impaired. Such impairment is common in many structures and might occur in the larynx as the result of antecedent traumatism, operative or accidental, as well as from long-continued irritation and congestion, injuring the walls of the blood vessels and preventing that rapid concentration of defensive leukocytes by which normal organs resist and overcome infection.

One of the first symptoms of tuberculosis in the larynx is a change in the voice. It becomes weak and thin, often giving the impression that the pitch has been raised, although it may be proved by tests of the vibrations that there is hardly any change in this respect. This vocal attenuation may go on to complete aphonia. As a diagnostic sign, the voice quality differentiates between tuberculosis and syphilis, the latter disease producing a harsh, raucous sound of normal volume. There

is a short, hacking cough, with little expectoration, unless there exists coincident suppuration in the lungs. At the beginning there is soreness, increased by swallowing and speaking, but not much acute pain; after ulcers have formed, the pain may be very severe. Paleness and swelling of the mucosa are shown by the mirror, but the glottis is not much narrowed and hence dyspnea is not marked.

FIG. 90.—Tuberculosis of the larynx. The true vocal cords have been destroyed. There is infiltration and ulceration of the ventricular bands, also infiltration of the arytenoid cartilages and interarytenoid space.

Tubercular ulcerations are a characteristic feature; they appear upon the vocal cords and the surface of the cartilages, particularly the arytenoids, thus showing a tendency to break out upon the posterior part of the organ, while syphilitic ulcers are much more apt to occupy the anterior section. They are shallow depressions of a dirty red color, with ill-defined edges merging into the unaffected mucosa of the intervening spaces. Their exudate is a thin, grayish muco-pus, sometimes streaked

FIG. 91.—Tubercular growths in papillary form occupying the interarytenoid space of the larynx.

FIG. 92.—Tubercular infiltration of arytenoid cartilages and the true vocal cord upon the right side of the larynx. (*Stout.*)

with blood from abrasions and containing numerous tubercle bacilli. Figs. 90, 91 and 92 are reproductions of laryngoscopic images, showing lesions of the vocal cords and adjacent tissues.

The first indication for treatment is to control the constitu-

tional disease; unless this is done the throat lesions will not improve, indeed they will almost certainly grow worse, for the blood will not be able to furnish plastic material to repair the damaged tissues. Nearly every conceivable treatment has been used in tuberculosis and the profession, as well as the public, has many times been misled by false hopes. The consensus of opinion, at the present time, puts chief confidence in the early and persistent employment of roborant measures, which aid the organism to antagonize the microbes and toxins, together with aseptic precautions to reduce to a minimum the further ingress of pathogenic agents. To be successful, these methods of treatment must take into account the patient's traits, idiosyncrasies and former habits of life; the effort to enforce a uniform rule of conduct is sure to fail. It is specially important to consider patients' financial and domestic circumstances, for the plan for restorative, hygienic living must be not only desirable, but also possible to carry out. The advice to make a long journey for a change of climate, given to a man who can hardly afford a week's end trip to the seashore, is merely mocking his misery.

A certain diagnosis, corroborated by a bacteriological test, should be made as soon as possible and the patient should be frankly told his condition and how important it is that he should faithfully carry out the treatment advised. If it be possible, he should follow an outdoor occupation, with active though not laborious work in the sunshine and open air. If this is not possible, his leisure and recreation hours should be spent in such surroundings. He should sleep either in the open air or in a room whose thorough ventilation makes its atmosphere nearly identical with that outside. Muscular exercise is beneficial, if not carried to the stage of fatigue. The garments worn next the skin should be of absorbent material to take up cutaneous secretions; the clothing over these ought to consist of fabrics which conduct heat slowly, so that the body may have some protection from the quick changes in temperature characteristic of our climate. Of course, the weight of clothes worn must be carefully adapted to the season.

The popular idea of a diet for tubercular patients is "high feeding." If this is understood to be a liberal supply of nourishing, agreeable food in large variety, it is right, but if it means to eat as much as possible, it is very far wrong. It is not the whole sum of food which nourishes the body, but only that part which is assimilated, so the power of assimilation must be the measure of quantity. Besides this, a check is imposed by the power to eliminate catabolic, or waste, products. Overfeeding with proteins may induce disease of the kidneys, a deplorable complication in a case of tuberculosis. The eggs and milk diet has sometimes been carried to a most injurious excess, even in sanatoria claiming close scientific supervision. The only way to secure for a patient a really suitable dietary is to watch the effects of the aliment taken, as to kind, quality and quantity, within the limits set by assimilation and elimination, and to follow the teachings of that experience.

If the constitutional condition shows improvement, we may expect amelioration of the laryngeal lesions and can assist the process by local treatment. The control of the cough is important and all irritating substances whether drinks, vapors, dust or smoke must be avoided. The use of the voice often proves an irritant and it is best to forbid all phonation, including whispering as well as singing and speaking. This prohibition proves, at first, a trial to female patients, but they soon grow accustomed to it and revert to the sign language with which one readily learns to express the ideas whose communication is most needful. Intralaryngeal injections do good service by modifying the cough and liquefying the secretions. Each day from ten to twenty minims of the following combination should be applied to the interior of the larynx with a syringe having a curved delivery tube and conical nozzle:

℞. Menthol..... gr. v
Creosote..... gr. v
Eucalyptol..... ♏vj
Guaiacol..... ♏vij
Olive oil.....q.s. ad. fl. ℥j. M.

Topical treatment of areas of infiltration varies in accordance with their extent. In all cases thorough cleansing of the larynx with Dobell's solution is required at least twice daily and oftener, if there is rapid accumulation of the discharges. This may be all that is necessary for it is best not to disturb small infiltrations, trusting that they will disappear as the constitutional condition improves. Infiltrations, however, causing symptoms either obstructive or painful, should be removed. This is best effected by cocainizing them with a twenty per cent. solution, the application being repeated in five minutes, and then dessicating them with the galvanocautery at a cherry-red heat. This is followed by insufflation of iodoform powder, or one of its substitutes. The subjoined combination may be used:

℞. Morphiæ sulphatis ..... gr. iv
Thymolis iodidi ..... gr. x
Acidi tannici ..... gr. v
Bismuthi subnitratis ..... ℥ss
Pulvis accaciæ ..... q.s. ad. ℥j. M.

Ulcers require to be thoroughly cleansed with Dobell's solution, anæsthetized with a twenty per cent. solution of cocaine and then cauterized by applying lactic acid with a cotton-tipped probang, using at first a fifty per cent. solution and gradually increasing the proportion of the acid, until full strength is reached. The use of the galvanocautery is an alternative procedure. The healing of the cauterized surfaces is promoted by insufflation with powders such as that above described. If dysphagia is especially severe, eating should be preceded by applying a four per cent. solution of cocaine with a probang, or a few drops of an eight per cent. solution as a spray. Lozenges each containing two grains of orthoform act very happily in some cases. A solution of ten grains of menthol in a fluidounce of liquid petrolatum, contained in a suitable atomizer, may be given to the patient for home treatment, and the throat may be sprayed with this remedy several times daily. Dobell's solution also may be used in this way. The patient must be urgently warned not to swallow his sputum or expectorated matter. These liquids swarm with germs and should be received into

vessels containing strong germicides, *e.g.*, chloride of lime. Instead of handkerchiefs, paper napkins should be used when walking or riding. These must be burned while still damp with the sputum.

Syphilitic laryngitis is almost always one of the secondary or tertiary manifestations of venereal disease, though a few cases of chancre of the epiglottis have been reported. It gives rise to mucous patches, gummata and ulcers, appearing in the order named, unless the morbid process be arrested. These local features bear to the constitutional disease a relation similar to that held by the throat lesions of tuberculosis to its effect upon the whole body, with this difference, that in tuberculosis the laryngeal affection is mostly subordinate to that of the lungs, while in syphilis the throat is the chief local focus and by its changing symptoms we form our judgment regarding the advance or repulse of the constitutional malady. In view of this fact the course of treatment, general as well as local, is mainly directed by the laryngeal conditions as they are observed from day to day.

Syphilis is caused by the spirocheta pallida, one of the smallest known micro-organisms. Lenses of very high power used by a skilful microscopist are necessary for the discovery of this germ and repeated examinations are often required to obtain ocular proof of its presence. Fortunately, the Wassermann and Noguchi reactions give evidence of the existence of the germs, even when they elude the microscopic test. A perfect demonstration is obtained when the ocular and chemical findings are mutually corroborative. When the diagnosis is open to doubt, the physician is wise to invoke the aid of the laboratory so that his opinion may be reinforced by all procurable evidence.[1]

[1] The question of syphilitic infection concerns not only pathology and therapeutics but has a bearing on many other relations, domestic, social, even political. The Emperor Frederick, father of the present ruler of Germany, died of a throat disease whose nature caused an acrimonious dispute between his English and German laryngologists. The controversy grew very bitter, was taken up by journals in both countries and produced ill effects of a permanent character.

Mucous patches are produced by the necrosis of the epithelial layer of the mucosa in clearly circumscribed areas. This exfoliation leaves a pinkish, vascular spot, tender to the touch, but giving little pain. The gummata are round-cell infiltrations of nodular appearance, occupying either the site of former mucous patches, or the intervening spaces. The ulcers are produced by retrograde, putrefactive changes in the gummata, which soften so that part of their substance becomes a decaying, pultaceous mass. This is cast off, leaving an annular depression, whose edges are clear cut and commonly, though not uniformly, indurated. A scanty exudation of purulent fluid comes from the ulcers and there is sometimes bleeding, due to erosion of the submucous capillaries. They are not very painful. All these lesions occur most frequently upon the anterior half of the larynx, while tubercular lesions show a preference for the posterior half. The characteristics of syphilitic ulcers just mentioned serve to differentiate them from those of tubercular origin, which are very shallow, have ill-defined edges and cause intermittent attacks of severe pain.

The remedies, par excellence, for syphilis are mercury and potassium iodide. Although we may be unable to give a full explanation of their mode of antagonizing the disease, their therapeutic efficiency is established as firmly as any fact in medical science and, to set them aside, in favor of some drug whose properties and powers are still in dispute, is to assume a very grave responsibility, both moral and legal. Now that the pathogenic germ of syphilis is known, we hope that serum therapy, which has given us the mastery of other destructive maladies, may furnish us with an antitoxin which will prove a true specific and signalize the victory over this universally dreaded disease; but that triumph is not yet won and until it is we must continue to employ those remedies whose curative powers are attested by world-wide experience through many generations. Salvarsan and neosalvarsan have passed through the stage of exaggerated popularity, the stage of reactionary criticism, and are still upon trial. In view of the many dangers

attendant upon their use, dangers which are accentuated by the method of intravenous injection upon which the advocates of salvarsan insist, these synthetic combinations of arsenic and chlorine cannot be regarded as antisyphilitics of general applicability. I do not advise their use except in cases which prove refractory to the mercurials and iodides, or which present some positive counter-indication. Occasionally one meets with idiosyncrasies, which forbid the administration of mercury and iodine, but these instances are rare.

Mucous patches should be cleansed by the spray of Dobell's solution, frequently employed. Some of them will heal without further treatment under the influence of mercurialization of the system. When granulation is tardy, silver nitrate should be applied to each patch with a cotton-tipped probang wet with a twelve and a half per cent. solution: sixty grains to the fluidounce. The occurrence of gummata and ulcers is an indication for speedily bringing the system under the influence of mercury, either by inunction with the unguentum hydrargyri or by hypodermic injections of a solution of hydrargyri bichloridum. Potassium iodide also should be exhibited in doses of from ten to thirty grains. Topically there should be thorough cleansing with the spray of Dobell's solution and then cauterization with the twelve and a half per cent. solution of silver nitrate, followed by insufflation with iodoform powder, or one of its substitutes.

Œdema, which sometimes occurs, must be treated as when of nonsyphilitic origin. If it cannot be reduced by astringents, or scarification, recourse must be had to tracheotomy, or to intubation, which will be subsequently considered. The healing of large ulcers may give rise to much cicatricial tissue, whose eventual contraction causes stenosis of the larynx. This unfortunate sequel is treated by stretching the scar tissue with Schroetter's laryngeal tubes which are graded in sizes of progressively increasing diameter. The constricting, cicatricial band may require division with a blunt-pointed bistoury. The good effect of this incision is liable to be counteracted by

the union of the separated segments, hence it is better, if the structural conditions permit, to remove a small V-shaped wedge of the band, so that the raw surfaces will heal by granulation without coming together. If this procedure is successful, it produces a permanent enlargement of the passageway, decidedly relieving the symptoms caused by the stenosis.

As diphtheria has already been considered in the chapters dealing with the nose and the faucial tonsils, it is necessary here only to advert to some special features of its laryngeal manifestations. In character the pseudo-membrane which forms in the larynx is identical with that observed in the nose and upon the tonsils, but in quantity it is often less. The coincident inflammatory symptoms and the involvement of the lymphatics are often less marked than in the nasal type. The great fatality of laryngeal diphtheria arises, not from the virulence of the disease, but solely from the closure of the glottis and the consequent suffocation. To avert this danger becomes the paramount object of treatment, as soon as the larynx is attacked. A hypodermic injection of antitoxin must be given as promptly as possible and while that remedy is bringing the disease under control, topical medication should be used and preparations made for intubation, so that it may be performed as soon as dyspnœa grows serious. If the patient is vigorous, free vomiting should be induced by a full dose of the wine or syrup of ipecac. In feeble, exhausted children, the strain of emesis may countervail its benefits. Two remedies have a well-established reputation for retarding the extension of the false membrane and rendering it less adherent and hence easier to dislodge: these are steam and mercurial vapor. A simple contrivance for their administration is made by having a bar of wood extend horizontally over the bed or crib, at the height of three feet above the child's head. This bar is about an inch in diameter (part of a broom handle can be used) and one end is firmly attached to a window frame, or to a block screwed, or nailed, to the wall; at the other end is fastened the center of a small sheet, which is draped over the child in the

form of a tent, the lower margins being secured to the bed by safety pins. Two upright slits are cut in this "tent" so as to form a curtain door, which is rolled up and pinned, leaving an opening large enough for any manipulations the nurse may wish to make.

A teakettle half filled with water is heated over a gas or oil flame until the steam comes off freely at the spout, and this steam is conducted into the tent through a rubber tube, whose free end is held as near the child's face as may be done without the risk of scalding. In this way the air within the canopy is soon saturated with warm moisture which is inhaled at every breath. The mercurial vapor is procured by putting ten grains of calomel upon a small shovel, or an iron spoon, and heating it over the flame until it begins to volatilize, when it is held within the tent as long as the fumes continue to rise. The atmosphere is thus impregnated with mercury in the form of vapor that produces the local effect of the medicine, often with good results.

In some mild cases, these measures prove sufficient to prevent obstruction of the glottis; but if the cyanosis continues and the dyspnœa is not relieved, intubation must be performed without delay. This very valuable operation is attended with one serious risk against which there is no absolute safeguard, that is the danger of pushing some of the false membrane down into the trachea, where it will act as a plug, causing speedy suffocation. It is plain that this accident is more likely to occur if the membrane is loosely attached, or if part of it is exfoliated, than if it be firmly adherent throughout its extent; for in the first case, the tube may push before it a separating fragment, while, in the second, the tube in its descent will glide over the surface of the firmly held membrane. We can rarely determine just what condition the membrane is in because a good visual inspection cannot be obtained. The laryngoscope cannot be satisfactorily used with young children, especially when they are struggling in pain and fear; hence our knowledge of the location and constitution of the pseudo-mem-

brane is necessarily imperfect. The only available precaution against impelling a fragment into the trachea is to wind a narrow strip of gauze around the tip of a curved applicator so that the free edge is in loose concentric layers, while the other margin is tied to the instrument, then to carry this broom of gauze down to the larynx and move it gently from side to side. If there are any loose fragments of membrane, they are apt to be entangled by the fringe-like edge of the pledget and to come away when it is withdrawn. In spite of our best efforts, the risk of occluding the trachea remains, and before intubation is performed all preparations should be made for doing a tracheotomy on a moment's warning, if we find the passage closed.

The intubation tubes invented by Edward O'Dwyer, by whom this operation was introduced, are seven in number, the three smaller ones being designed for infants of one, two and three years and the other four intended for those whose ages are four to five, six to seven, eight to nine, and ten to twelve, respectively. A tube consists of a hard rubber sheath of cylindroid shape somewhat enlarged in the middle to promote its retention in the larynx. The upper end has a flange, designed to rest upon the posterior laryngeal wall next to the œsophagus; at this end also there is a thread hole through which a three-foot piece of floss silk is passed and its ends knotted together to furnish a retractor. A metal bar called the obturator fits inside the hard rubber sheath; its lower end is smoothly rounded and by projecting slightly beyond the inclosing sheath, it facilitates passage through the larynx, while its upper end is cut with a screw thread which fits a corresponding screw in the instrument termed the introducer. This consists of a steel handle and a shank bent at nearly a right angle and having at its distal end a screw thread corresponding with that upon the obturator. Parallel with the shank there is a fork which can be thrust forward by a knob on the handle and which, when so advanced, pushes against the hard rubber tube, thus withdrawing the

obturator from its interior. Another necessary implement is the extractor. It has a metal handle and a curved shank consisting of two coaptated arms working on a pivot and terminating in jaws whose holding surface is made by indentations upon their outside. When the hard rubber tube is to be withdrawn, the closed jaws are inserted into the upper end then, by pressure on a lever, the jaws are opened, their exterior dentations take hold of the tube upon its inner surface, and bring it out together with the extractor.

When all preparations for the intubation are complete, the child is wrapped in a sheet extending from the neck to the ankles whose folds confine the arms to the side and hold the legs in apposition. He is then seated on the left knee of the nurse, his limbs extending downward between hers and his head resting upon her left shoulder. This is the preliminary posture, but at the moment of introducing the tube, the patient's head should be lifted by an assistant and sustained by the palms of the hands applied over the ears, since in this position the intrapharyngeal space reaches its greatest dimensions. The surgeon stands facing the patient and adjusts the mouth gag whose handles extend across the left cheek and are steadied by the nurse. He then inserts the forefinger of his left hand into the pharynx, following the median line. Using this finger as a guide he introduces the tube. Its first position is flat upon the middle of the tongue, the curve of the introducer bending over the center of the lower jaw and the handle, grasped by the surgeon's right hand, extending downward parallel to the child's sternum. The silk thread has been secured to the little finger of the operator's right hand and is thus kept free from entanglement.

The left forefinger now advances to the larynx and finds the nodular eminences on the top of the arytenoid cartilage; it then lifts the tip of the epiglottis and doubles it over toward the root of the tongue (Fig. 93). At the same moment the handle of the introducer is raised, causing the tube to advance across the epiglottis bringing the end of the obturator directly above

the glottis. The guiding finger now returns to the arytenoid eminences to prevent the obturator from passing beyond them

FIG. 93.—Intubation of the larynx. The forefinger of the operator's left hand lifts the tip of the epiglottis and bends it over upon the root of the tongue.

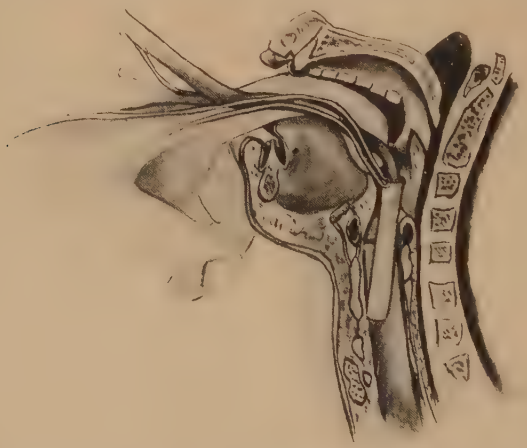


FIG. 94.—Intubation. The introducer is horizontal in the mouth and the tube occupies the lumen of the larynx, the flange resting upon the posterior wall.

and entering the œsophagus. Carefully and with very little force, the handle is raised, until it has circumscribed an arc of ninety degrees and projects from the mouth in a horizontal

line (Fig. 94). At this moment, if all has gone well, the tube should occupy the lumen of the larynx, with the flange at its top resting upon the arytenoid cartilage. Every step so far may have been right, but the peril is great, for the tube in the larynx is a closed tube and the air is cut off. Therefore, as quickly as possible, the guiding finger is brought to the flange to hold the tube in position, the knob on the introducer is pushed toward the fork and the obturator withdrawn (Fig. 95). Restoration of free breathing is generally signalized by a few

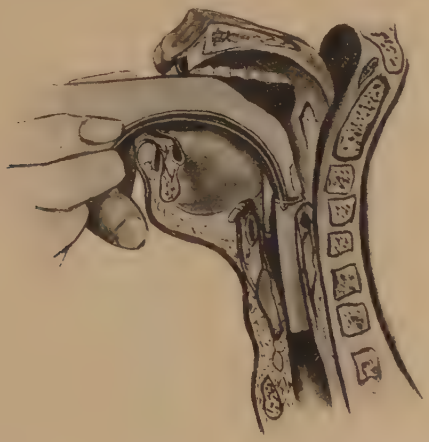


Fig. 95.—Intubation. The obturator is released from the tube and withdrawn, leaving the passage open for respiration. As a precuation, the silk thread is, for a time, left attached.

short coughs which are speedily followed by amelioration of all the symptoms; the cyanosis disappears; the depressions above and below the clavicles grow less and less and soon the child falls into a deep sleep. If possible, the surgeon should remain for an hour after performing intubation, to make sure that all details have received proper attention and that the plan of subsequent treatment is well understood. The purpose of the silk thread is to recover the tube, should it have passed into the œsophagus; when there is certainty that it occupies its proper position in the larynx, the thread should be removed by cutting it

near the knot and then making traction upon the knotted end.

The success of intubation depends largely upon working in the median line which is the best road to take, and also on observing the arytenoid eminences as a demarcation to avoid passing into the œsophagus. If a mistake occurs, the only thing to do is to withdraw the tube and try again, but the situation is peculiarly trying, because of the peril involved in delay. Sometimes the tube becomes loose and is coughed

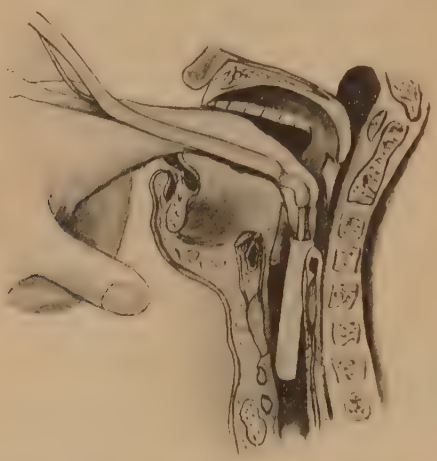


FIG. 96.—Intubation. When the tube is no longer needed, it is withdrawn with the extractor guided into the orifice by the forefinger of the operator's left hand.

up. Otherwise it is left in place for from three to seven days, when the pseudo-membrane has been exfoliated. It is then removed with the extractor, a procedure depicted in Fig. 96.

While a child is wearing a tube, its feeding is a matter of serious concern. The escape of solid or liquid food into the trachea may cause such violent coughing that the tube may be expelled and the patient suffocate before any one can be procured who has skill to reinsert it. One way to obviate the danger is to rely exclusively on milk and to give it through a soft catheter which enters the nose and passes thence through

the pharynx into the œsophagus, or even the stomach. Another plan is to give the patient liquid food in small portions while he lies on his back with the head lower than the chest, so that gravity may act to prevent anything entering the larynx. A third method is to depend wholly upon rectal feeding with predigested aliments, and as the period, when these extraordinary precautions must be taken, is only a few days, at most, it would seem that rectal alimentation which gives perfect security against both solids and liquids invading the larynx, is a rational solution of the problem. It is not an efficient method of sustaining nutrition, but is fairly satisfactory as a temporary expedient.

CHAPTER XXIV

LARYNGEAL NEOPLASMS

New growths in the larynx, like those occurring elsewhere, are classified as benign or malignant. Those of the first class include papillomata, fibromata, lipomata, angiomata, chondromata, adenomata, cysts and polypi. In this country papillomata (Fig. 97), occur so frequently as to outnumber all the others combined. Their structure shows a mesh of connective tissue filled by the infiltration of round cells and traversed by

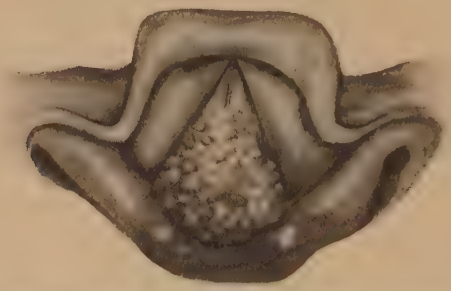


FIG. 97.—Papilloma of the larynx; a multiple growth almost completely covering the vocal cords.

minute blood vessels. They are covered by squamous epithelium of unusual thickness whose surface presents a rough, warty appearance and a pale, pinkish hue. They may be single or multiple and may be attached to the mucous membrane by either a broad base or a slender pedicle. These growths most commonly spring from the vocal cords, the ventricular bands and the epiglottis, and some of them are found in the subglottic region.

Next in clinical importance are the polypi: soft, pale, pedunculated tumors, very similar to the nasal polypi already de-

scribed, but usually of firmer structure on account of a larger proportion of connective tissue. They very often spring from the vocal cords, being attached to either their upper or lower surface. Cysts, which sometimes attain a considerable size, are enlarged and modified mucous glands whose orifices have been occluded and which have in consequence been distended by the retained secretion. They are of spheroidal shape and have broad bases.

The other varieties of benign neoplasms are comparatively rare. In company with the three just mentioned, they have certain common characteristics. They are nearly painless and grow slowly, often existing for months without causing any marked symptoms. When symptoms do occur, one of the first is impairment of the voice which becomes weak or hoarse and may be (at a later stage) suppressed. A curious vocal phenomenon is sometimes observed. After being quite hoarse for weeks, the voice suddenly regains its normal character and the patient supposes himself well, till after a variable time the hoarseness returns as suddenly as it disappeared. The explanation is that a pedunculated tumor, usually a polypus, was wedged between the vocal cords near either their front or rear extremity and impaired phonation until, by some expulsive rush of air, its bulbous part was thrown on top of the cords, leaving the glottis free from everything except the slender pedicle; this movement restored the voice and it remained normal until some strong inspiration carried the pendulous bulb back to its old position and the symptoms of obstruction returned.

When a neoplasm becomes large, it impairs respiration and dyspnœa is added to the vocal symptoms, especially when the growth is sub-glottic and is hence in a constricted position. There is also some cough, but very little expectoration and no hæmorrhage. Dysphagia is a symptom when the tumor is at the posterior part of the larynx near the œsophagus.

In the treatment of multiple papillomata of small size, good results have followed the topical use of alcohol. The remedy, undiluted, is put into an atomizer with a long delivery

tube and the spray thrown into the pharynx for several minutes, the procedure being repeated four or five times a day. Constriction of the vessels and ischæmia follow this treatment and the papillomata gradually shrink until nothing is left but the scale-like remains of the warty epithelium; these, too, finally separate from the restored mucous membrane and are coughed up. The larger papillomata and the neoplasms of other varieties require surgical treatment and can be removed either by the intralaryngeal method or through an external incision in the median line of the throat. The operation from the inside is done in two ways. The technique of the first is to render the interior of the larynx anæsthetic by swabbing it twice with a twenty per cent. solution of cocaine upon a cotton-wound applicator, and then cutting away the growth with a curette or forceps, the operator being guided by an image reflected in the laryngeal mirror which is constantly kept in position, being held by the surgeon's left hand.

A great part of the instruction concerning diseases of the larynx is imparted by means of figures and colored plates, hence it is unfortunate that nearly all our text books print these pictures without correcting the lateral reversal of the image caused by the laryngoscope, as by other mirrors. For example, in a recently published text book, written by a professor of high standing, there is a drawing clearly showing a polyp springing from the left vocal cord, yet the printed description, immediately below, says the polyp is on the right vocal cord, and similar errors occur frequently in this work. Contradictions of this sort are very confusing to a student and it is strange that they remain uncorrected, in edition after edition of works designed for use as text books.

The second way of operating induces anæsthesia, as has been already described, but dispenses with the laryngeal mirror and employs the tube devised by Chevalier Jackson which has the great advantage that there is direct illumination of the field of operation instead of its reflexion in a mirror. This instrument is a strong metal tube an inch in diameter

bent twice at right angles, so that the proximal section serves as a handle grasped by the surgeon's left hand. The distal section holds a vertical position from the lips to the top of the larynx; at its lower end is a flange by which the epiglottis is engaged and bent toward the root of the tongue, and a little above this is fastened a very small incandescent lamp. Electric conductors pass from this lamp up through this third section of the tube and at its end make connection with the rheophores of a battery. When the circuit is closed the top of the larynx is brightly lighted and the surgeon operates by passing his

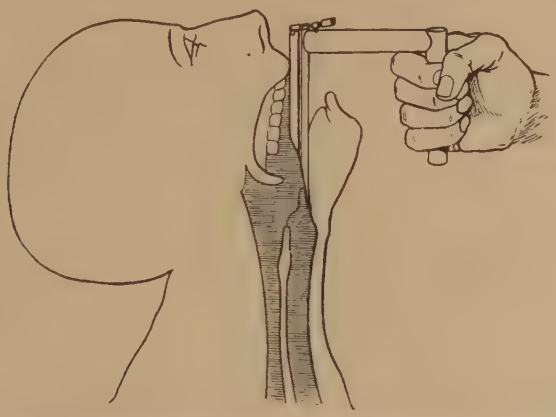


FIG. 98.—Misleading schema of direct laryngoscopy and bronchoscopy. (*Jackson.*)

instruments through the tube. Difficulties were experienced by some surgeons in using the tube invented by Jackson and he was convinced that they arose from faulty technique, especially in regard to the posture of the patient. At the meeting of the American Medical Association in 1909, he exhibited diagrams of the correct and incorrect positions. These are reproduced in Fig. 98 and Fig. 99.

Neoplasms may be ablated with forceps whose jaws are serrated, or have cutting edges. Jaws ending in ring-shaped curettes are sometimes best. Some growths are most easily grasped by blades which open laterally, others by those having

an anterior-posterior motion. The usual mechanisms in which the blades are held together by a pivot which acts as a fulcrum answers the purpose in many cases, but where there is very little room we may best use an instrument with a curved, hollow shank at the distal end of which the jaws protrude and are opened and closed by the movement of a sliding knob near the handle. For work of this kind it seems necessary to have a considerable number of instruments, so that a proper selection can be made adapted to the peculiarities of each case.

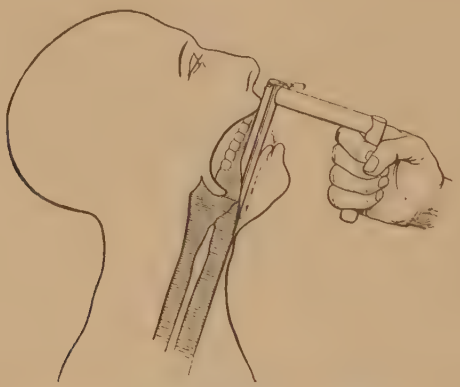


FIG. 90.—Schema showing correct position of patient and of the instrument in relation to the air passages. The instrument should touch the upper teeth very gently if at all. (*Jackson.*)

In all intralaryngeal operations, especial care must be taken to avoid injuring the normal structures, particularly the vocal cords, for there is always a possibility of postoperative dysphonia, even entire loss of the voice. After a tumor has been removed the raw surface at its base should be touched with lactic acid.

External operations are in general to be avoided, but may be necessary when neoplasms are so situated in the sub-glottic space that they cannot be extirpated from above, and also where great dyspnœa creates urgency for immediate clearing of the breath-road. After a sufficiently long vertical incision has been made in the median line and has penetrated the

anterior wall of the larynx, the tumors are very accessible and can be removed without difficulty. As there is considerable laceration and the incision is made in structures which cannot be kept in a state of absolute rest, the healing process is attended with risks; accurate apposition of the surfaces is hard to secure and there is liability to cicatricial deformity. This, however, is not inevitable and in some cases there is complete recovery with unimpaired phonation. Killian, who originated the use of direct illumination in laryngeal examinations, has introduced within the past three years a modification of this technique, termed "suspension laryngoscopy." This procedure employs a speculum of large lumen attached to a handle and shank bent at a right angle and supported, not by the surgeon's left hand, but by an overhead beam or crane to which one end is fastened by a hook or chain. When the speculum is passed into the throat, an adjustable mouth-gag, with which the instrument is fitted, prevents slipping or displacement by the weight of the head. The body of the patient rests upon a table or frame whose height is so regulated that the weight of the head is borne by the speculum which by this traction is pressed toward the anterior wall of the throat. After these adjustments have been made, the other steps of the examination are similar to those taken when the speculum is held by the hand. Among the advantages claimed for suspension laryngoscopy are that the weight borne by the speculum keeps it very close to the front wall of the throat, thus bringing into view the anterior commissure of the larynx which is often so far forward as to be out of the line of vision, and that mechanical suspension greatly facilitates the surgeon's work by releasing his left hand which otherwise would be occupied in the constant and wearisome task of holding the speculum. Relieved of this, he can employ a bimanual technique throughout the operation.

Malignant neoplasms are found almost entirely in the forms of epithelioma and sarcoma, the former being five times as prevalent as the latter. They occur in men more frequently

than in women and, like cancers in adjacent regions, belong to the latter decades of life. Their symptomatology differs from that of benign tumors in that they are darker in color and harder in consistency than most of those, and also grow more rapidly, are painful and have a tendency to hæmorrhage. Symptoms should not be relied on for the differential diagnosis. If there be a suspicion of malignancy, a shred of the growth should be taken for microscopic examination. Hope of cure is limited to small growths in their very early stages, and the sole procedure which has a prospect of success is thorough extirpation by the external method of operation: a radical measure which removes entirely that half of the organ which is effected. In advanced cases and where there are malignant growths upon other organs, treatment is only palliative.

CHAPTER XXV

LARYNGEAL EXTRANEA

Foreign bodies of many kinds reach the larynx either through mental immaturity or, later, through incapacity and carelessness. The proneness of small children to put things in their mouths is not a sign of perversity, as some people think, but the survival of an infantile practice, based on a very good reason. The baby's fingers are weak and fragile, but its jaws are relatively strong, its alimentation depends on the firmness of their grip without which there would be no suction, and the little creature soon learns to hold the objects it desires in the strong grasp of the maxillary muscles which are much more trustworthy than the feeble and uncertain hands. The fact that the mouth is not available as a general receptacle and also as a universal tool is a later mental acquisition and for a good while the old habit influences the child's actions. Once the articles are in the mouth, their passage into the larynx may be due to a great variety of accidents. Among older persons, the lodgement of extranea in the laryngeal region is favored by mental incapacity such as is seen in the insane, where it is often conjoined with some anæsthesia of the larynx and its surroundings. Intoxication renders the throat temporarily less sensitive than usual and while this condition lasts the drunken man may be unconscious of the presence of foreign bodies which have slipped back from the mouth. As soon as he becomes sober these extranea signify their presence by pain, cough and dyspnœa. The very reprehensible carelessness which allows patients to eat heartily shortly before the inhalation of an anæsthetic, is responsible for many accidents. Vomiting occurs while the patient is relaxed and un-

conscious and some of the half digested food is apt to enter the larynx, even the trachea and bronchi.[1]

Another cause of these accidents is the habit of upholsterers to fill their mouths with carpet tacks to be dropped one by one and driven into the floor. It is a most dangerous practice, but many workmen with almost incredible stupidity continue it, even at the risk of losing their situations in shops where it is forbidden.

Sharp or pointed articles, such as tacks, may lodge in different parts of the organ; smooth particles are most frequently found in the ventricles, where they may remain a long time, giving rise to few symptoms until their position is accidentally shifted and their presence thus manifested. Dyspnœa may not be observed unless the foreign body is lodged directly over the glottis and is sufficiently large to obstruct half of it; cough is usually present, but it is attended with little expectoration, hence a cough of this character, not readily explained in other ways, should create suspicion of an extraneous object, especially when the patient is a child or an adult of feeble mentality.

The object of treatment is, of course, to remove the foreign body, but to this statement must be added the caution that efforts for removal must never be made in a way which may push the object further down, into a situation where it will be much more dangerous, perhaps changing a case of partial obstruction into a case of fatal suffocation. There is a popular notion that when anyone has a foreign body in the throat, he should be slapped violently upon the back, and perhaps turned so that his head is lower than any other part of the body. Small children are often wholly inverted and held suspended by the feet. Of course, there is a chance that, in such a posture gravity may cause the extraneum to drop into the mouth, but the position is so unnatural that

[1] A surgeon was asked, "What does vomiting during general anæsthesia signify?" His reply was both wise and witty, "It is a sign that somebody on the hospital force should be discharged."

it is liable to do much harm and, in adults particularly, it involves danger of cerebral congestion. Besides this, the foreign body may be moved into some situation where it is harder to dislodge than it would have been in the locality primarily occupied. Often a physician is not called until the members of the family have tried many expedients to get rid of the obstructing object and have made the patient's condition decidedly worse.

If the dyspnœa is not urgent, a careful examination of the larynx should be made under the best illumination the circumstances permit. The laryngeal mirror may be used or the tubular speculum of the Killian or Jackson pattern, already mentioned in the discussion of neoplasms (Chapter XXIV). The Jackson tube has the great advantage of furnishing ample illumination at the point where it is needed, free from the drawbacks incident to reflected light. On the other hand, it restricts still more the small space in which we must work. If the foreign body cannot be found and the danger of suffocation increases, or if, when located, it cannot be dislodged and there is risk of it going down the trachea we must perform tracheotomy, and then make the extraction. After the offending body has been removed, the tracheal wound may be closed at once, provided there has been no laceration except the operative incision and no prior trauma of the larynx, but if damage has been done, it is safer to keep a tracheotomy tube in place until the danger of swelling of the glottis is past. In the more favorable cases, which are also the more numerous, the extraneum can be seen and is accessible to properly contrived instruments. When this is so, it should be grasped with jaws, which will not permit it to slip, and carefully withdrawn. There are various types of forceps adapted to this procedure. Those whose jaws are opened and closed by means of a sliding knob near the handle have the advantage of occupying less space than those working on a pivot. Tuerck devised an instrument with a handle fitted with a sliding knob which controls the posture of whatever

jaws are attached to the shaft; they may be serrated, fenestrated or of other pattern. The shaft itself is a flexible sheath and can be curved to meet the situation of the extranea as the jaws are made to suit their character.

The removal of a foreign body may cause some excoriation of the laryngeal walls and some bleeding, usually slight. Until all discomfort has passed away, the organ should have rest from phonation. Just after the operation it should be sprayed with a fifty per cent. solution of peroxide of hydrogen, and a two per cent. solution of cocaine may be used as a spray four or five times during the subsequent twenty-four hours, if there is much soreness. After that, spraying with normal salt solution three times daily is all that is likely to be required.

CHAPTER XXVI

LARYNGEAL NEUROSES

The nerves of the larynx are the superior laryngeal whose function is motor and the inferior, or recurrent laryngeal, which conveys motor and also sensory impulses; both have their origin in the vagus. In addititon to these cranial nerves, there are small filaments given off from the sympathetic. The left side of the larynx is more liable to neuroses than the right, a fact attributed to the course of the recurrent nerve on that side, which on account of its proximity to the aorta, is affected by aneurysm of that artery.

Sensory abnormality may take the form of anæsthesia, hyperæsthesia or paræsthesia. In the first condition, attention is directed to the morbid state by the frequency with which food and drink "go the wrong road." The patient's meals are interrupted by attacks of violent coughing, even when the food is unirritating and is eaten slowly. The glottis does not close and hence the breath-road is not occluded, as it should be during deglutition. In the anæsthesia the muscles lack their appropriate nervous stimulus and fail to perform their normal function. This symptom is often the only one observed, unless there is coincidently present some motor neurosis. Laryngeal anæsthesia may be one of the sequels of diphtheria; when this is the case, much benefit may be expected from the administration of strychnia (strychnia sulphate, gr. $\frac{1}{60}$, three times daily), as in other forms of nerve atony produced by the diphtheritic toxin. This treatment may be reinforced by faradization, a mild current being distributed through the laryngeal region by holding a sponge electrode on each side of the throat below the angle of the jaw. The current derived from an electromagnetic battery should be strong enough to be felt, but without pain, and

should be continued for ten or twelve minutes, reversing its direction each minute. This treatment given daily will usually confer all the benefits to be derived from electricity, without carrying an electrode directly to the larynx. Even where the anæsthesia is not of diphtheritic origin, the coördinate use of strychnia and faradization often renders deglutition more normal, but when the cause is some cerebral or medullar lesion the laryngeal disorder cannot be expected to disappear until that cause has been removed.

Hyperæsthesia is usually due to some irritation in the pharynx, fauces, or nose; frequently to hypertrophy or varix in the lingual tonsil. Its cure depends upon the successful treatment of these causal conditions. Paræsthesia also has mostly a peripheral origin, unless it be subjective. Patients complain of various annoying sensations, as of some small solid body changing its position from the root of the tongue to the lower end of the larynx and *vice versa;* pricking by pin points; hairs stretched across the passageway and sometimes heat or cold. These sensations may be due to morbid changes in the lingual tonsil and other structures above the larynx, but they are generally experienced by persons described by the very expressive, though nearly indefinable term, "nervous," and we must bear in mind the probablity that many of the alleged pains are subjective, and really occur only as manifestations of some one of the protean forms of hysteria. In so far as they are objective, the best treatment is to correct whatever is abnormal in the upper air pasages and, even in the subjective cases, such measures give a fair hope of success, for there is always a chance that physical restoration of an organ, or a function, may induce a favorable psychic alteration.

The motor neuroses may arise from causes which are either peripheral or centric, and they occasion muscular spasms (tonic or clonic) or paralysis. The larynx has many muscles and, as each one may be affected in a sthenic and also asthenic way, the possible number of neuroses makes an extended list, but as the importance of these contractions and relaxations depends

upon their influence upon two functions, respiration and phonation, the majority are of only secondary interest, while those having a marked effect upon the breath and the voice deserve special attention.

The arytenoid and crico-arytenoid muscles are the adductors of the vocal cords; unilateral spasm of these muscles brings the cord upon the affected side to the median line of the glottis and affects the quality of the voice, but air passes up and down on the other side and there is little embarrassment of respiration: when however the spasm is bilateral, the cords are brought into contact, the glottis is closed and suffocation becomes imminent; a condition which is the characteristic feature of laryngismus stridulus, or false croup. This disease has already been fully considered in Chapter XXII. I believe that inflammation of the catarrhal type is an important and nearly constant factor in this disorder and hence it should be classified as one of the varieties of laryngitis. Some authors consider it a pure neurosis, on the basis of certain cases which lack signs of inflammatory action, but those rare cases do not seem sufficient to justify such a classification. A difference of opinion in this respect does not change our judgment regarding treatment, the method advised in Chapter XXII, being founded upon clinical experience and having the approval of those holding the neurotic theory, as well as those placing the affection among the inflammations.

The laryngeal crisis of locomotor ataxia, aphonia spastica, laryngeal chorea and laryngeal vertigo; all have, as a common factor, spasm of the adductor muscles of the vocal cords, generally bilateral and, when severe, imperilling life by suffocation. The treatment of these conditions depends mainly upon the diseases of which they are manifestations, but as dyspnœa is the common danger, so it is the common indication to relieve constriction of the breath-road; whatever else may be done afterward. For defense against suffocation, chloroform and the other antispasmodics recommended in the discussion of false croup (Chapter XXII) constitute our main reliance. If they fail, tracheotomy must be performed.

Paralysis of the adductors of the vocal cords is precisely the reverse of the condition above considered. The abductors, being left without their normal restriction, pull the cords toward the sides of the larynx, leaving the glottis wide open. Obviously this neurosis does not stop respiration, for the breath-road is kept all the time at its greatest width, but the voice is affected by failure to approximate the cords and, when both sides are affected, there is aphonia. The symptoms are very uncertain, as the nerve control over the muscles is apt to be intermittent; aphonia may continue for days, even weeks, and then a sudden fright or some other intense emotion may cause such a strong neural impulse that the patient will cry out in natural tones. This restoration of the voice may be lasting, or a relapse may come with equal suddenness. Aphonia of this type is common among neurotic patients. The discovery and cure of lesions affecting the air passages and also the superior and recurrent larnygeal nerves are a part of the treatment; if there be no organic disease, or if one that exists can be cured by medical or surgical measures, then there is a favorable outlook, if we can improve the innervation of the arytenoid and crico-artytenoid muscles by faradization and such roborants as strychnia, arsenic and iron. Remembering too that some of the symptoms may be subjective, the patient's psychic condition has a bearing upon the prognosis which will be much improved if her full confidence is gained and if she makes a sustained effort to retain any ground which has been gained and to avoid whatever has an injurious effect either in diet, clothing or occupation, as shown by experience during the progress of the affection which is commonly quite chronic in its course.

Paralysis of the abductors has the same mechanical effect as spasm of the adductors; the vocal cords are brought together with the risk of impeding respiration. The hindrance is chiefly to inspiration; the somewhat flabby cords offering very little obstruction to the expired air. This condition is usually permanent, unless caused by pressure upon a nerve

trunk by a removable tumor, or a syphilitic growth amenable to treatment. Patients suffering from bilateral paralysis of this kind gradually adapt themselves to it, acquiring a tolerance due to habit. They dare not take violent muscular

FIG. 100.—Paralysis of adductor muscles on both sides, associated with hysterical aphonia.

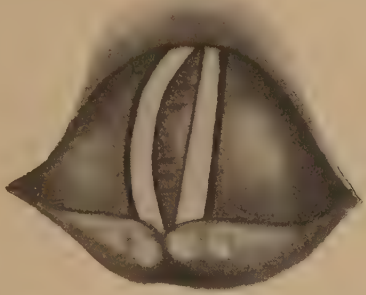


FIG. 101.—Paralysis of the right recurrent nerve, in a case of stab wound of the neck.

exercise and are never wholly free from the danger of a suddenly developed dyspnœa, imperilling life.

The forms of paralysis portrayed in Figs. 100, 101 and 102, are among those of frequent occurrence and as noted in the

FIG. 102.—Paralysis of the arytenoid muscle in a case of acute laryngitis.

titles of the illustrations may be associated with morbid conditions of wider scope; such as inflammation or hysteria. When existing, these complications have a bearing upon the indications for treatment.

CHAPTER XXVII

THE EAR: FORM AND FUNCTION

Otology is almost wholly a development of the last half century. Prior to that time the literature of the subject was meager and the few medical men who had acquired special knowledge and skill were ocular surgeons who devoted the bulk of their time to patients suffering from diseases of the eye and the remainder to the much smaller number who sought ear treatment. In popular estimation, failure of hearing was esteemed an inevitable accompaniment of advanced age and, when deafness began in the fifth or sixth decade of life, it was accounted a sign of somewhat early senility and the man "growing hard of hearing" was advised to try an ear trumpet and to practice the virtue of resignation. Comparatively few sought help from the medical profession and the profession itself had not yet awakened to the great possibilities of aural therapeutics. Treatment of the ear, in so far as it was a specialty, was in the hands of practitioners termed "oculists and aurists," the aurist function being as secondary in fact as in title. This condition continued until the time when the specialties were rearranged and, in study and practice, the ear was separated from the eye and associated with the nose and throat where it naturally belongs. This change in classification was a long step in advance and marked an epoch in scientific progress, which was also signalized by the general adoption of the term, otology, as the proper title for this department; a word which previously had been seldom used. Under the new conditions, the study of the ear has made rapid strides toward that breadth and accuracy which are commensurate with its great importance.

In Chapter I there is a graphic exhibit of the relations to the

breath-road sustained by three accessary organs, performing functions intimately associated with respiration; yet having separate and distinctive purposes. Of these the olfactory nerves, giving rise to the sense of smell, and the larynx, producing the voice, have already been considered. The third accessary organ is the ear, which originates the sense of hearing. The mechanism of this special sense is more complex than that of olfaction or phonation. It is not only unique in the complicated character of its anatomical and physiological features, but it has ramifications extending into diverse fields of knowledge; it is the basis of the distinct and highly developed science of acoustics and also of music, probably the most important, as it is certainly the most ancient of the fine arts.

The study of the ear is rendered difficult by the fact that there are many variations in structure both congenital and developmental, so that the organ in one individual presents features lacking in another. These variations may be slight and constitute merely peculiarities, or they may be so marked as to be termed anomalies. The peculiarities and even many of the anomalies do not interfere with the functions of the organ and hence come within the scope of nonpathologic deviations from the typical formation. It is important to remember the existence of such deviations and to be on the watch for them when operating, for the knife edge may be close to a nerve or a vascular sinus whose usual location would be at a safe distance, and the danger of such proximity must keep the surgeon constantly on his guard. Variations of this sort are seldom a primary cause for operation, unless they prove disfiguring. By comparing a large number of normally functionating ears and by noting those features which are most frequently present, the anatomists have been enabled to present a typical organ, regarded as the perfect, healthy ear, and this has been delineated with great skill in drawings and models. By studying this type we can secure a clear idea regarding this very complex organ and then add a knowledge

of the variations found in dissection and in observations on the living subject.

The aural structures are so situated upon and within the sides of the skull that they naturally comprise three groups, termed the external, the middle, and the internal ear. The first two perform the function of conduction; the third that of perception. Before entering upon anatomical description, we must consider a fundamental question which has paramount importance, because its answer is the basis of our conception of the entire subject and also determines the language to be used throughout the discussion of otology. What is hearing? The answer to this question must be clear, accurate and divested of all that is nonessential, if we are to avoid that confusion of thought displayed by many who have tried to write definitions and descriptions. Probably the best way to gain the right idea is to consider what happens when we hear a sound. The sensation of hearing, like other sensations, results from the excitation of the distal end of an afferent or sensory nerve, for functionally the labyrinth is an amplification of the end of the auditory nerve. Something excites the labyrinth and the auditory nerve conveys to the brain a perception called sound. The thing which excites the labyrinth is vibration. It may take different roads to reach the internal ear; a vibrating body, like a tuning fork, may be held outside the external ear, then the vibratory movements are transmitted through the air in the meatus and through the structures in the tympanum to the labyrinth; or the fork may stand upon the forehead, then the transmission is through the skin, subcutaneous tissues and bones of the skull to the same terminal point, but till it reaches that point it is always vibration and becomes sound only in the perceptive organism of the internal ear. We define sound as vibration interpreted by the ear. Where there is no ear, there can be no sound; waves may beat against a coral reef far out at sea and cause powerful vibrations in the air, the water, and the solid reef itself, but if there is present no animated creature endowed

with hearing, all the commotion produces no sound. Sound originates in sensation which can exist only where there is a living, sensory nerve; but vibration exists everywhere, in the earth, in the surrounding atmosphere and in the interstellar spaces. The vibrations, which the ear interprets as sound are comparatively slow movements, transmitted through matter in a solid, liquid, or gaseous state. The much more rapid vibrations which the eye interprets as light, are transmitted through the all-pervading ether.

The afferent nerves distributed through the body are subject to excitation by vibratory movements affecting their distal ends, but they are not so highly specialized as the nerves of sight and hearing and the perceptions they convey to the brain do not translate the causal vibrations into other forms of force, but express them as vibrations. How much knowledge the brain can get from these perceptions is a question whose active study is but recent and the methods of investigation are still tentative, but we already know that while the ear alone is the organ of hearing, yet the information hearing gives the brain is, in some degree, corroborated or corrected by the action of the nerves of general sensation. If ideas derived from this source can be substituted for the ideas derived from audition, then there will open before us a therapeutic prospect almost boundless, for defects in hearing will be supplied, not by mechanical devices, but by a parallel channel of neural transmission through which the vibratory cause will finally give rise to the same idea which was produced by the uninjured organ of hearing.[1] If this result shall

[1] A great impetus has been given to the study of this subject by the marvelous achievements of Helen Keller, who in early childhood suffered the loss of both sight and hearing. The girl's mind, imprisoned in total darkness and absolute silence, with unflagging persistence sought to establish communication with the outside and aided by the faithful devotion of Miss Sullivan, her teacher, attained success. The olfactory and gustatory nerves gave assistance, but on account of their specialization, they could supply perceptions only in the scope of smell and taste, for all else the only resource was the afferent nerves which take cognizance of vibrations and transmit to the brain vibratory perceptions. The language of vibrations was the only means of communication between the girl's

be attained, it will be an even greater therapeutic triumph than the saving of a limb whose main artery becomes occluded, by promoting anastomotic circulation until the collateral vessels develop into adequate substitutes.

The external ear includes all the auditory structures outside of the membrana tympani, or drum-head. Its first part projects from the side of the head, between the articulation of the lower jaw and the mastoid portion of the temporal bone, and is composed of a thin layer of cartilage whose surface is corrugated by large elevations and depressions. This, being outside the skull, is the visible section of the organ and is called "the ear" in common, colloquial language, while in anatomical descriptions it is termed the auricle or pinna. Its natural size is shown in Fig. 103. Nearly all the cartilaginous border is curled upon itself in a direction away from the head, and this inflected edge is called the helix. Its continuity is broken in two places: at the bottom, where it is replaced by a pendent pouch of skin filled with connective tissue and fat, named the lobe, and just above this on the front, where there is a conical eminence, the tragus, on the plane of the zygoma. Directly opposite the tragus is a smaller projection, the antitragus, and between these is the beginning of the external auditory meatus. The antihelix is a bifurcated ridge separated from the helix by a groove and having at its bifurcation the triangular fossa; below this and terminating in the meatus is a deeper concavity, called the concha. On

mind and the world—a poor medium it seems to us in the light of the slight use we make of it—but by this slender bridge the chasm was spanned, intercourse was established, knowledge of many kinds acquired and finally a course taken at Harvard University and its successful completion attested by the conferring of a degree. These nearly incredible facts have proved that the nerves of general sensation possess powers and possibilities which have remained unrecognized until the present time, and men are now seeking for a practicable method to utilize these powers and to make these nerves serve as substitutes for the nerves of the special senses, when they are disabled. The outlook is full of promise, particularly for those cases where audition is injured, but not destroyed, and where the internal ear may be so reinforced by the perceptions of afferent nerves that the combined actions will produce a nearly normal result.

the posterior or mastoid side of the auricle there is a conspicuous convexity which touches the convexity of the concha and then sinks to the level of the surrounding skin, the two dermal surfaces, diverging from the separating groove, being usually in contact. The auricle is attached to the side of the head by the integument and also by two ligaments, the anterior connecting it with the zygomatic process and the posterior

FIG. 103.—The auricle, or visible part of the ear. (*Morris.*)

joining the convex cartilage behind the concha with the lower part of the mastoid. The cartilage of the auricle is covered in some parts by strands of connective tissue and by a network of vascular and lymphatic vessels, all being enveloped in the dermic and epidermic layers of the skin, which in most individuals is rather thin; sebaceous and sweat glands are numerous in the concha. The muscles consist of striated fibers of slight strength; the superior auricular draws the auricle upward, the anterior draws it forward and the posterior draws it backward, but in many persons these muscles exert so little power that the auricle is stationary unless acted on by

extraneous forces; a few individuals possess extensive muscular control, similar to that exercised by many of the lower animals. The temporal branch of the trigeminus and the auricular branch of the vagus are the sensory nerves of the auricle and the external meatus. The arteries are branches given off by the temporal and external carotid; the veins unite in a single trunk, which enters the temporal vein.

The external auditory meatus is a canal extending from the concha to the membrana tympani. Its entire length, in the adult, is nearly an inch and a quarter, about half an inch being taken up by the external or cartilaginous section, which structurally is a continuation of the auricle, the recess of the concha assuming the shape of an elliptical orifice with its longest diameter vertical and gradually changing to a horizontal position in a deeper section of the canal. From this entrance the direction is forward and inward and then downward, at an obtuse angle, where the cartilaginous section joins the other portion. The first part of the meatus is not completely inclosed by cartilage; the tubular wall exhibits fissures which are filled by fibrous tissue. Its interior is lined by skin continuous with that of the auricle, and in this are imbedded the usual cutaneous glands, with the addition of the ceruminous glands which exist in this locality only. They are tubules which by convolution take a spherical shape, the free end acting as an orifice for secreting a peculiar brownish-yellow substance, the cerumen or ear-wax. The breaks in the cartilaginous cylinder, fissures of Santorini, are transverse to the course of the canal and render it flexible. They are important pathologically, because the fibrous tissue with which they are filled is less resistant than cartilage and permits infections to enter the canal from the surrounding tissues and also to pass from within outward.

The second portion of the canal is somewhat longer than the first, measuring about three-fourths of an inch; it is also narrower. Its interior is lined with a very thin, closely adherent skin which becomes continuous with the membrana tympani,

and it is inclosed by a wall of bone developed during infancy from an osseous ring which terminated the canal during fœtal life; a vestige of this antenatal condition remains in the narrow groove, sulcus tympanicus, in which the drum membrane is inserted. The structure of the meatus in both its sections and its close proximity to very delicate organs render

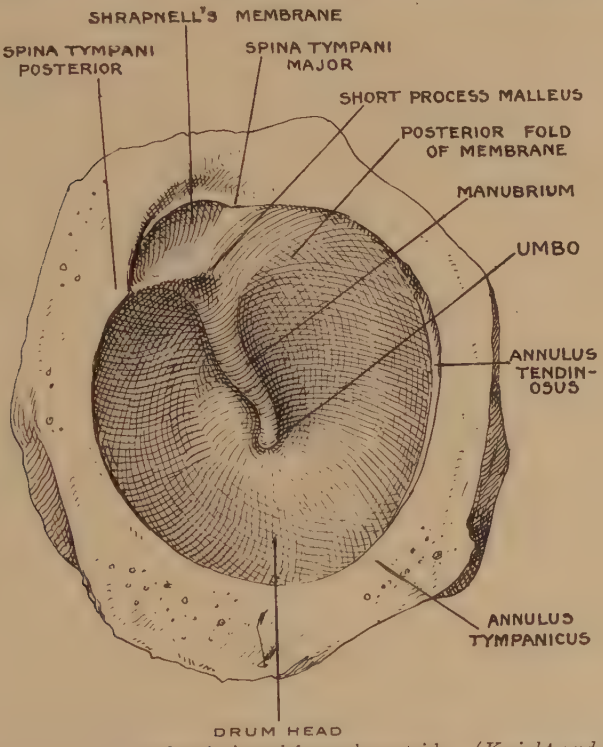


FIG. 104.—The left drum-head viewed from the outside. (*Knight and Bryant.*)

it a passageway that will not bear rough handling. Harsh and hasty instrumentation may work much injury and will be avoided by the careful surgeon.

The middle ear consists of the tympanum, the drum-head, the ossicles, the attached ligaments and muscles, the antrum and the mastoid sinuses. The Eustachian tube also is most appropriately included in anatomical descriptions, because of its con-

nection with these structures. The tympanum, or drum, so named on account of its form, is a cavity in the petrous, or hard, portion of the temporal bone. The drum-head (Fig. 104) is nearly circular, but the space beyond this is an irregular quadrilateral, whose longest diameter, in the adult, is between one-half and three-fourths of an inch, while the short diameter from the drum-head inward is one-sixth of an inch. All of the wall which surrounds the cavity is osseous and belongs to the temporal bone; it has no natural segmentation, but for convenience there is an artificial division into roof, floor, anterior part and posterior part. The roof is an arch separating the tympanum from the cranial cavity; the space under this is called the attic or vault and the larger cavity below is termed the atrium. A lamella of irregular surface constitutes the floor which aids in forming the carotid canal; both roof and floor are without orifices. The anterior part of the wall has an orifice for the upper end of the Eustachian tube and through the posterior passes the inlet to the mastoid sinuses, an opening of great importance in its pathological relations. The partition inclosing the tympanum on the inner side is penetrated by the fenestra ovalis, an elliptical aperture one-eighth of an inch long which leads into the vestibule of the labyrinth, and by the fenestra rotunda, a circular aperture closed by an elastic membrane, which responds to movements of lymph within the labyrinth. Above the oval window is the Fallopian canal, giving passage to the facial nerve.

The outer partition, dividing the middle ear from the external auditory meatus, comprises the membrana tympani, the annulus tympanicus, the membrana flaccida and the scutum. Of the three layers entering into the composition of the membrana tympani, the one in the middle is the most important; it consists of fibers disposed in two strata, in one of which the arrangement is circular, in the other radiating. Over this central characteristic layer the other membranes are reflected, the skin, being a continuation of the integument of the meatus, covering the outer surface, and the mucous mem-

brane, projected from the lining of the tympanitic cavity, covering the inner surface. At the upper part there is a notch, where this fibrous layer is wanting, and here the conjoined skin and mucous membrane fill in the vacancy with what has been termed the membrana flaccida, because it is thin and relaxed. At this point there is frequently found a minute orifice, the foramen of Rivinius. It does not lessen functional power, and it is an unsettled question whether this opening is congenital or of traumatic origin. The center of the membrana tympani moves outward or inward in accordance with the presence of positive or negative air pressure in the middle ear; when at rest, it is somewhat retracted so that a slight concavity is presented toward the meatus. In color the membrane is pearly grey and, when normal, translucent, so that the malleus, which is imbedded on the inner side, shows through; the short process of this bone, which appears as a yellow spot near the upper margin, is one of our chief landmarks in making examinations of the membrana tympani. Another conspicuous feature is a luminous triangle, whose apex is near the center of the membrane and which extends downward and forward nearly to the circumference.

The ossicles of the middle ear are named malleus, incus and stapes from a supposed resemblance to a mallet, anvil and stirrup. In the third case there is an actual likeness, in the others it is fanciful. From the position of the short process of the mallet, its handle extends to the center of the membrane, a point called the umbo. The malleus articulates with the incus and this bone with the stapes, whose base fits into the oval window at the entrance of the labyrinth. By this means the ossicles establish a chain for the transmission of vibrations from the drum-head to the internal ear which interprets these vibrations as sound. A collateral road for transmission exists in the air inclosed in the tympanum, but this does not convey impulses with the same measure of force. The inner aspect of the membrana tympani of the left ear is depicted in Fig. 105.

The Eustachian tube, beginning by an orifice in the anterior wall of the tympanum, takes a course downward with an inclination toward the median line, until it terminates in an aperture on the side of the naso-pharynx, at the level of the posterior nasal orifice. Its upper third, half an inch long, has an osseous wall; the other two-thirds are inclosed by cartilage. The narrowest part of the tube is the junction of the bony and cartilaginous sections, and this is termed the isthmus. The interior is throughout lined by mucous membrane continuous with that of the naso-pharynx and, like it,

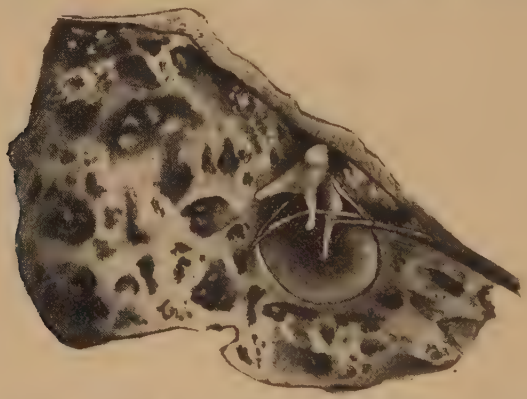


FIG. 105.—The outer wall of the middle ear (left side) viewed from the tympanic cavity; showing inner surface of drum-head, malleus, incus, tensor tympani muscle and chorda tympani nerve.

covered by a ciliated epithelium. A layer of adenoid tissue is found beneath the mucous membrane in the cartilaginous portion, but this does not extend above the isthmus. The Eustachian tube is generally closed, but in swallowing and yawning the edges of the lower orifice are separated by action of the levator and tensor palati muscles and leave an elliptiform aperture. Even when these edges are in contact, air and liquids entering at the tympanic extremity readily pass down to the throat, and the tube serves to drain and ventilate the middle ear.

The mastoid sinuses are irregular cavities in the interior

of this portion of the temporal bone, communicating with each other and connected with the tympanum by the antrum on its posterior side. They are lined with a thin mucous membrane having a squamous epithelium.

The internal ear, of which an enlarged representation is given in Fig. 106, is a very complex and delicate mechanism. Its function is acoustic perception, or the interpretation of

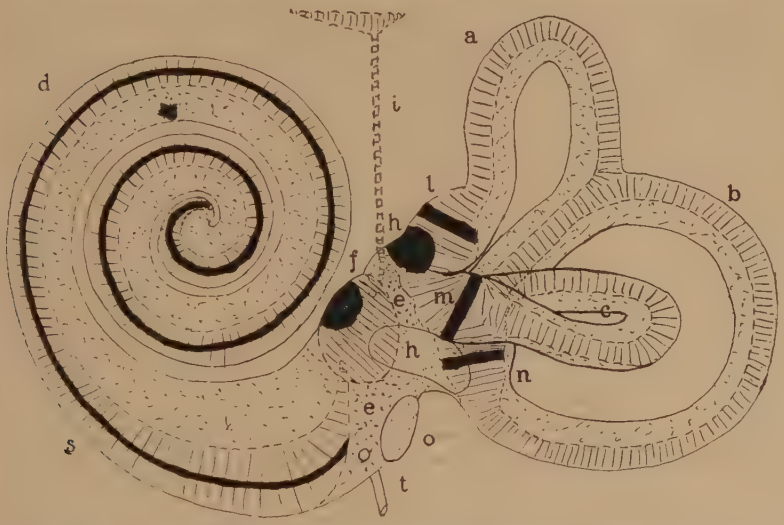


FIG. 106.—The labyrinth Viewed from the outer side. (*Knight and Bryant.*) *a*, Superior semicircular canal; *b*, posterior semicircular canal; *c*, external semicircular canal; *d*, cochlea; *e*, vestibule; *f*, sacculus and macula acustica sacculi; *h*, utriculus and macula acustica utriculi; *i*, Ductus endolymphaticus; *l*, ampulla of superior semicircular canal and crista acustica; *m*, ampulla of external semicircular canal and crista acustica; *n*, ampulla of posterior semicircular canal and crista acustica; *o*, round window; *p*, oval window; *s*, scala media and papilla acustica; *t*, ductus perilymphaticus.

vibratory impulses as sounds, and it comprises the labyrinth, both osseous and membranous, the internal auditory meatus and the auditory nerve. The semicircular canals are included in the anatomical description because their structural connection with these bodies is so intimate, although the belief long held that they played a part in audition is now generally given up and they are thought to indicate the stations and movements of the body and the three dimensions of space.

The labyrinth begins at the oval window of the tympanum and contains the vestibule, the cochlea and the semicircular canals. Though imbedded in the petrous portion of the temporal bone, it has an osseous envelope of its own which at birth can readily be separated from the surrounding bone, although later the two coalesce. The vestibule is an ovoid cavity between the tympanum and the internal auditory meatus; at its top is found the superior cribriform spot and on its anterior wall the middle cribriform spot; these spots are pierced by a group of minute foramina leading into the internal auditory meatus; close to this is the terminus of the cochlear passage termed the vestibular scala.

The semicircular canals, designated superior, posterior and inferior, are so situated that their surfaces would lie parallel to three faces of a cube, viz., the base and two sides meeting at right angles. Each of these canals has one expanded end, the ampulla, which enters the vestibule; two of the other ends unite and then take the same course, while the third enters separately. There are thus five orifices connecting these canals with the vestibule. Inside of the vestibule and the semicircular canals is a group of membranous structures, comprising three tubes, fitting upon the inside of the semicircular canals, and two pouches, located within the vestibule and named the spherical saccule and the elliptical saccule, or utriculus. These delicate structures and also the membranous cochlea are surrounded by a serous liquid called the perilymph which intervenes between them and the osseous walls by which they are enveloped. In each saccule is a minute body composed of crystals of calcium carbonate and termed an otolith. These ear-stones perform some necessary functions, as is implied by their presence in connection with the auditory apparatus of most of the lower animals, even those lacking many parts of the internal ear, as seen in man.

The cochlea, so named from its resemblance to the shell of a snail, is a bony tube an inch and a half long, curled around a central axis so as to make nearly three spiral turns, each one ris-

ing above the former and the tube growing smaller in diameter toward the apex. This apex, or top, is called the cupola. A spiral lamina partly osseous and partly membranous winds around the axis of the cochlea, dividing the tube into two passageways which are separate from the base to the cupola where they unite by an orifice termed the helicotrema. One of these passages terminates at the round window of the tympanum and is designated the scala tympanica, and the other passes into the vestibule and bears the name scala vestibuli. The interior of the membranous labyrinth is occupied by the endolymph, a serous liquid similar to the perilymph just described: it circulates through the scala vestibuli, the scala tympanica and the remaining intramembranous spaces. Although the amount of this fluid is very small, it serves to fill the delicate canals and to maintain the contour of their membranous walls, its pressure outward being equalized by the inward pressure of the perilymph, which is interposed between the membranes and the exterior osseous wall of the labyrinth.

The cochlear nerve, a branch of the auditory, has a great number of terminal filaments distributed over the internal surface of the cochlea and ending in the hair cells. This neural mechanism is termed the organ of Corti.

The internal auditory meatus is an osseous canal less than an inch in length giving passage to the facial nerve and to the cochlear and vestibular branches of the auditory with the trifurcation of the vestibular, also to the auditory artery which divides upon the same plan as the nerve, the vascular and neural branches ramifying side by side. After leaving this meatus the trunk of the nerve proceeds to the hearing centers in the cerebrum.

The physiology of the ear, like that of the eye and other organs of special senses, depends on the power possessed by certain highly specialized nerves to interpret physical and chemical phenomena as sensations and perceptions of a particular and unique kind. The sensations and perceptions with which the ear is concerned are those of sound, and the phenomenon inter-

preted is vibration or oscillation. Any elastic body, whether solid, liquid or gaseous, can be thrown into vibration and the organ of hearing can take cognizance of this occurrence. The ears of aquatic animals deal with vibrations of water and some such animals are nearly deaf when taken out of their natural element. As man normally lives in the terrestrial atmosphere, the great majority of vibrations which come to the human ear are transmitted through the air. When we speak of the external and middle ear having the function of "conducting," the word refers to the vibratory impulses which are conducted from the atmosphere to the receptive organism, the internal ear. The auricle is said to collect the wave-like oscillations taking place in the air and the ridges of the helix and antihelix, as also the depressions of the concha and triangular fossa, are supposed to render the process more complete. There is no doubt that undulations of the atmosphere transmitted through a tube are rendered stronger if the receiving end is expanded into a saucer-like concavity, with the orifice at the center, and the auricle, which has its orifice at the point of deepest concavity, exerts some such influence; but observations upon varied formations of the cartilaginous plate and upon persons who through traumatism have lost a part of it, together with comparisons of the hearing of those with small and those with large auricles, lead to the conclusion that the rugosities and convolutions have only a slight effect either in rendering the oscillations stronger or in making them more distinct; an oval, concave plate of smooth surface appears to have equal, practical efficiency.

The external auditory meatus continues the transmission of undulations and plays an important part by removing the tympanum from the surface to the inside of the head where it is not only withdrawn by a full inch from an exterior position, in which it would be liable to many accidental injuries, but is inclosed in the petrous portion of the temporal bone, one of the hardest structures in the osseous system. In some of the lower animals the membrane is level with the skin and is easily destroyed. The head of the drum by its toughness gives much protection

to the delicate parts within and also supplies a vibrating tissue which changes the transmission through air to transmission through bone, represented by the ossicles, although some impulses likewise pass through the air incarcerated within the drum. After the membrana tympani, the chief road for the undulations is through the malleus, partly imbedded in that structure, the incus, which articulates with the malleus, and the stapes, whose top is jointed with the incus and whose base fills the oval window. At this aperture there occurs another change in the medium of transmission for, as at the drum-head vibration in air gave place to vibration in a solid (bone), so here the medium is altered from a solid, the stapes, to a liquid, the endolymph, circulating through the scalæ of the cochlea. As the drum is protected by hard bony walls, so its included air is afforded an opportunity for safe condensation and rarification, under the influence of changing temperature and other causes, by a canal, the Eustachian tube, a well-protected outlet and inlet for the air and for liquids as well. This tube performs the double function of ventilating and draining the middle ear and is also a collateral channel for the transmission of atmospheric undulations.

In the cochlea there is another change in the medium through which the vibrations pass, this being from a liquid to a solid, from the endolymph to the terminals of the auditory nerve. At this stage in the process vibration, a physical phenomenon, becomes sound perception, a manifestation of vitality. This act of hearing, to which all the other processes lead up, is mainly performed in the cochlea, though some of the contiguous structures supplied by branches of the auditory nerve probably take part in it.

The statements already made rest upon a solid foundation. That vibrations proceeding from the middle ear produce effects upon the cochlea and that immediately afterward neural impulses pass from the terminal filaments of the auditory nerve to the auditory centers in the brain—these are facts universally accepted. The intermediate steps are not so sure. The process by which vibration transmitted to the cochlea becomes

a neural impulse traversing the nerve is still a theme for theoretical discussion. The anatomical structures are so minute and fragile that investigations are restricted to expert microscopists using high power lenses. Experience has shown indubitably that inquiries pursued under such conditions are subject to much difficulty and great liability to error. Therefore conclusions reached by these investigations must be received with caution and we must bear in mind the difference between fact and hypothesis.

The theory of cochlear functions, which has won most favor among otologists, is advocated by Prof. Bezold of Munich and its main points are given in his lecture upon The Physiology of Hearing.

"Von Helmholtz explained the power of the ear to distinguish tones of varied pitch and also to discriminate among sounds simultaneously heard by establishing the theory of the mechanical analysis of impressions of sound in the cochlea.

"The rods of the zona pectinata in the basement membrane of the cochlea are stretched like the strings of a piano. According to Henson's measurements they increase in length nearly twenty-fold from the shortest fibers in the base convolution to the longest in the cupola. Von Helmholtz recognized these rods as resonators for the whole scale, which are stretched by a complicated apparatus in Corti's organ and transmit their vibrations directly to the layers of hair cells of the auditory nerve. Any number of impulses, which reach these rods simultaneously will cause a corresponding number of them to vibrate simultaneously. The perception of those causing the highest pitch is accomplished in the basement coil and of those causing the lowest pitch in the cupola of the cochlea."

Certain facts regarding the semicircular canals and also the elliptical sacculus and utriculus, with their contained otoliths, while not strictly a part of the physiology of hearing, have such diagnostic relations as will require their consideration further on, and the same is true of some details not necessary in the general outline given in this chapter.

In discussing the larynx attention was called to the fact that the gift of voice is restricted to a small part of the animal kingdom. A similar statement is true regarding the sense of hearing, though this is much more widely distributed than phonation. As we go from man downward through the various orders of animal life the auditory apparatus grows simpler and, on the lower levels, it appears adapted to three purposes only: to warn the animal of the approach of one of its natural foes, to aid it in its search for food and to recognize calls uttered by members of the opposite sex. Some of the mammalia, like the deer and the wolf, have very acute hearing for a narrow range of sounds, but the human ear alone is capable of great diversity in quality and a very extended register as to pitch. An ear which is free from disease and has been well trained is able to recognize notes originating in thirty-two double vibrations per second (the lower limit) and those due to 32,768 double vibrations (the upper limit). As the highest note in each octave signifies just twice as many vibrations as the lowest, the total range of appreciable tones is ten octaves. The lowest note of the fourth octave from the start is usually called the fundamental; it has the pitch given by the middle C of the piano keyboard and is produced by 256 double vibrations per second.

It is a curious fact that the ear has a range of perception far greater than the eye. The different colors recognized by our vision depend on different rates of vibration in the luminiferous ether; the lowest number of oscillations producing the red ray, and progressively greater rapidity giving rise to orange, yellow, green, blue and violet, while beyond the violet there are atinic rays influencing chemical reactions, but giving no light because the eye is incapable of interpreting them. Now the rapidity of vibration increases from color to color, but before the rate for the red ray is doubled we have passed through the violet and into the darkness. So it appears that the eye can perceive only six color notes, less than one octave, while the ear recognizes in sound notes ten octaves, each containing seven, or a total of seventy notes.

CHAPTER XXVIII

AURAL EXAMINATIONS

An aural examination is concerned with three things: (1) The anamnesis, or history of the case; (2) the present condition of the organs as revealed by sight and touch (sometimes also by smell) both with and without instrumental assistance; and (3) the degree of sound perception indicated by acoustic tests. Every beginner should train himself to a systematic method of examination, the topics being taken up in logical order, so that each one suggests that which is to follow. A tyro may think such a plan slow and that he can go faster by picking out the important points in a haphazard fashion but those who have formed the systematic habit find it a great time saver. It also prevents their omitting details which otherwise are apt to be overlooked, necessitating subsequent inquiry. In addition, information systematically acquired is far better retained by the memory.

The anamnesis comes to us usually from the patient or some friend who accompanies him; their statements being occasionally supplemented by that of a physician previously in charge who has referred the patient for special treatment. A narrative of the case prepared by an observant and well-educated practitioner is likely to be of great value to the otologist. Unfortunately such a narrative is seldom furnished—most men are too much hurried to tell it or write it out—and the specialist must do the best he can with the halting story of the patient, who does not know many of the facts and has no nomenclature for those he does know. When it is possible to get an account from the former medical attendant, it is certainly wise to do so.

The case history, useful in all diseases, has often a peculiar value in those of the ear, a value arising from the manner of telling it, aside from the facts communicated. When questions are asked during the physical and functional examination, the patient's replies are often rendered untrustworthy by an unconscious or subconscious bias, or by some neurotic hindrance. Statements regarding responses to the acoustic tests are often vitiated in these ways; but while telling the story of his past troubles, the patient acts naturally and frankly; his method of talking and his hearing, or failing to hear, questions put in different tones of voice, will give to the experienced and tactful otologist a great deal of information on which he can rely because it is elicited in a way that does not excite neurotic perversity.

After learning the usual "identifying facts"—name, residence, age, marital relation, with number, sex and ages of children living or deceased, we should inquire as to the parents and grandparents and also brothers and sisters, whether they have suffered from aural diseases and whether deaf-mutism has existed in any branch of the family. We must learn the occupation (which may be a causal factor) and the patient's habits and mode of life, also the state of his health from childhood, with any serious maladies or accidents. Coming now to the aural affection for which treatment is sought we inquire its supposed cause with the circumstances and date of its beginning; the progress it has made and whether there have been intermissions or periods of partial recovery. These facts have a bearing on the prognosis which is more favorable if the disease is recent than of long standing; if due to nasal obstruction, than to some constitutional malady; also when partial deafness follows catarrhal attacks or the use of drugs, than when it is congenital or a sequel of traumatism or some infection like that of scarlatina or tuberculosis. The above outline of interrogations is only suggestive of a proper wethod of verbal inquiry whose object is to bring out all facts mhich may throw light upon the present condition of the patient. Any arbitrary plan would prove a hindrance rather than

a help to a capable physician who must in this matter, as in all others, use his own judgment and common sense.[1]

The second stage in the examination ascertains the condition of the various parts of the auditory apparatus by sight and touch frequently assisted by diagnostic instruments. A number of these are described in Chapter III under the caption Armamenta, and, when they are mentioned in the following pages, that description will be cited; other instruments will be explained in connection with the use to which they are applied.

For this physical examination the patient should occupy a strongly made revolving chair such as that described in Chapter III, which should have, in addition, a mechanism for raising or lowering the seat for a range of three or four inches, thus giving facilities for change of level as well as for bringing either the right or left ear under inspection, without removal from the seat or interference with the light. As sunlight is liable to interruption by weather changes and other causes, we must generally depend upon artificial illumination and this is satisfactorily supplied by the lamps, condensers and reflectors, described in Chapter III.

It is best to begin the orderly examination by inspection with the unaided eye. This will collect more information than we would at first suppose; it tells whether the auricles and contiguous structures on both sides are symmetrical; whether an auricle is abnormally large or abnormally small; whether there is crop-ear, flap-ear, negroid ear (pouched lobule) or any other disfigurement of the external cartilaginous part; also whether it is affected by furunculosis, herpes or eczema. It likewise notes the posture of the patient's head and the movements made when there is an effort to hear indistinct sounds. All these particulars and others should be the subject of observation.

Palpation, *i. e.* touch, or pressure with the finger tips, will sup-

[1] The inquirer is not slavishly restricted to a mandatory list of questions nor to ask for some fact, which stands out before his eyes, like the doctor of whom it is told that a new patient, on entering the office, introduced her escort as her son; but a few minutes later the physician, following a list of questions, committed the gross *bêtise* of asking her whether she had ever been married.

plement the knowledge gained by the eye. It detects the caloric change upon inflamed surfaces and the fluctuation in tumefactions when any motile liquid is present—serum, blood, or pus; it develops the peculiar pitting of saturated tissues in œdema; it detects crepitus and shows the presence or absence of tenderness under pressure and of pain when traction is made upon the auricle.

The curvature of the external auditory canal and the presence of hairs at its entrance usually prevent visual inspection without instrumental aid very near the ostium, and the finger is arrested close to the same point by the narrowness of the meatus. In proceeding further, we require the assistance of a speculum or otoscope. While there are several varieties of aural specula in the market, I have found that the instrument devised by Gruber (Chapter III) answers all practical purposes. We select from a set of Gruber specula the one best fitted to the size of the meatus and sterilize it by boiling. If it has subsequently grown cold, it should be warmed before use to a temperature 10° or 12° F. above that of the body. If the right ear is under examination, the surgeon, sitting on the patient's right side, seizes the auricle between the index and middle finger of his left hand and draws it upward and backward so as to lessen or wholly remove the curvature in the meatus; and holding the speculum between the thumb and forefinger of his right hand passes it into the canal, using very gentle pressure and stopping if there is pain. The position of the speculum must, of course, conform to the shape of the canal, whose perpendicular diameter is longer than the horizontal and the direction of the instrument is upward, forward and inward, or "it slants toward the nose." If the speculum is stopped and yet no obstacle is apparent it should be withdrawn and one of smaller size substituted. Successful introduction is much promoted by the tact derived from practice. When the membrana tympani is brought into view its surface is well illuminated by rays reflected from the head mirror and the triangle of greater brightness normally present should be clearly shown and also the

outline of a part of the malleus seen through the translucent tissues. The pearl-gray color, usually attributed to the drum-head is liable to some modification in health and may be greatly changed by disease. Siegle's otoscope and the Delstanche masseur (described in Chapter III) cause outward and inward movements of the membrane, which give a fair idea of its motility and indicate whether any part of it is bound down by adhesions.

The mastoid sinuses have important pathological relations not only to the tympanum but to intracranial structures and their condition may have much diagnostic significance. The passage by which they communicate with the tympanic cavity is a cell, the antrum, which opens upon the rear wall and, as this is behind the drum-head, it cannot be seen with the aural speculum; therefore, the information accessible is confined to that given by inspection outside that membrane and to touch. Swelling, redness, tenderness, or deep-seated pain in the mastoid region point to the existence of inflammation and its extent may, to some degree, be inferred by the severity of these symptoms. If, after the tympanic cavity has been emptied of pus it refills rapidly, there is a valid inference that the secretion comes from a large surface and hence that the mastoid sinuses as well as the tympanum are concerned in the process. Our diagnosis is necessarily more a matter of induction than of direct observation and the exact location of mastoid lesions is often revealed only during operation. Furthermore, in this region there is so much variation from the typical anatomy that the surgeon must be constantly on his guard. He may have made an incision through the soft parts over the site of the fossa sigmoidea and proceeds to cut through the periosteum, when suddenly the blade penetrates deeply and a flow of dark blood shows that he has opened the lateral venus sinus. The accident occurs because in this particular skull the sinus, instead of being protected by a firm plate of bone, is covered by a mere scale hardly thicker than writing paper. The only way to avoid such mishaps is to proceed with continual caution, testing the nature

of each structure encountered, before taking the next operative step.

The Eustachian tube drains and ventilates the tympanum, hence its permeability is a matter of much importance, and knowledge regarding this is the first object of the tube's examination. There are several methods, all being alike in sending a current of air from the pharyngeal orifice and observing whether it reaches the tympanum, or is arrested on the way. The escape of the air at the upper end of the tube is recognized by the patient on account of the peculiar sensation produced. This is usually trustworthy but is liable to error and should be corroborated by use of the auscultation tube (see Chapter III). It is simply a yard of rubber tubing fitted with an ear piece for the patient and another for the physician, who judges whether the passage from the throat to the middle ear is open, partly by sound and partly by the impact of the air impelled into the tympanic cavity. He will learn by experience to recognize certain modifications of these sensations and to attribute them to altered conditions in the Eustachian tube or tympanum, or in both.

Valsalva's method is the simplest plan and is adapted to cases where the tube is normal or but slightly obstructed. The inflation can be performed by the patient without assistance and is often entrusted to him. This is both an advantage and a disadvantage; on one hand it facilitates the daily distention of the tympanum, in conditions where positive air pressure is beneficial; on the other, there is danger that the patient will make the distention too often and too forcibly, thus producing a relaxation of the drum-head. The procedure is very simple, the patient with his mouth shut takes a full inspiration and closes the nostrils by digital pressure; he then makes a forcible expiration. This forcible expiration causes a condensation or positive pressure in the naso-pharynx and the air finds an outlet through the Eustachian tube toward the tympanum where, at the moment, there is less pressure and a condition of relative rarefaction. The expired breath will traverse the tube

only when the lower orifices are patulous and, with the purpose of assuring this condition, many text books teach that at the moment of expiration the patient should swallow (Toynbee's experiment). This is wrong and nullifies the Valsalva procedure; for in swallowing the velum palati rises and shuts off the naso-pharynx from the rest of the throat, so that the breath forcibly impelled upward by the lungs does not reach the Eustachian orifices. Around them in the naso-pharynx and in the nasal fossæ there is a region of negative pressure continuing from the previous inspiration. While in the meso-pharynx and in the mouth there is positive pressure, no force is acting upon the air to impel it upward through the tubes.

Politzer's method uses, instead of the expired breath, a column of air artificially impelled through the nasal passages against the orifice of the Eustachian tube. The intranasal blast is supplied by a Politzer air bag (Chapter III) which is held in the surgeon's right hand, while its nose-piece is inserted into one of the nostrils and the alæ nasi are compressed by the middle and ring fingers of the left hand. The pressure exerted is gentle, just sufficient to keep the nozzle steady and to close the nasal vestibule. It is never necessary or justifiable to press hard enough to cause pain or epistaxis. Dr. Strawbridge directed that when the bag and tube were in this position the patient should swallow some water, previously held in the mouth and, just as the larynx moved upward in the median line of the throat, the bag should be compressed impelling nearly half a pint of air into the naso-pharynx whence it would pass up through the Eustachian orifice made patulous by the act of swallowing. Dr. Gruber modified this technique by dispensing with the aid of deglutition and having the patient say the syllable "hick," in a forcible manner. This act causes a retraction of the soft palate and a gaping of the Eustachian orifice, the effects following the act of swallowing, and the air bag is compressed at the rising of the larynx, as already described. The Politzer method is applicable to cases where there is more obstruction than would yield to the Valsalva plan. The pressure

upon the bag should at first be gentle and, if this fails to inflate the tympanum, the force should be cautiously increased, but never to any great extent if the obstruction is unilateral, because the compressed air affects both sides and there should be little interference with the normal, unobstructed tube. As obstruction requires more force in the air current, its effect when it overcomes the obstacle is proportionally greater and the blast entering the tympanum may distend the drum-head and impart to the patient a sensation which is very distinct though rarely painful. The sound perceived by the surgeon using the auscultation tube varies in accordance with the conditions present. A dull click or thud signifies the somewhat forcible entrance of the air into the tympanum; whistling or hissing indicates that there is a perforation of the drum-head, and bubbling or gurgling proves that there is a liquid of some kind in the cavity—a diagnostic sign of decided importance.

When efforts at inflation by the Politzer method prove fruitless, resort must be had to the Eustachian catheter. This is an instrument made of silver, or hard rubber, having a length of from four to six inches, one end being enlarged to a hollow cone to accommodate the nozzle of an atomizer or air bag and the other end having a very smooth bulbous terminal, to avoid wounding the mucous membrane. Back of this end the catheter has a curve, which is an arc of a circle, whose diameter is two inches, and near the conical end is a small ring fixed upon that side, which has the concavity of the curve, this ring indicating the position of the instrument when most of it is hidden in the nasal cavity. This description of the catheter conforms to the type usually sold in the shops and commonly found in use in the hospitals, but some high authorities teach that it should always be made of virgin silver and furnished as a straight tube leaving to the surgeon the opportunity to bend it to any shape he may desire and which the great flexibility of pure silver renders practicable. In their opinion a catheter whose curves are determined by the requirements of each case is a better instrument than one made upon the pattern of an un-

changing model however good that model may be. Prior to the introduction of the catheter the nose should be thoroughly cleansed with a detergent spray and the instrument, sterilized by boiling, should be lubricated with sterile petrolatum. The use of cocaine is a mooted point. Some authorities advise applying a two per cent. solution to the walls of the lower meatus with a cotton carrier as a routine procedure; others claim that this is necessary only in hyperæsthetic persons. There is doubtless much difference among patients and a good deal among those examining them. A well-informed mind and a skilful hand may in many instances dispense with the anæsthetic. If it be found that the instrument is causing a great deal of discomfort it can be withdrawn and the membranes desensitized. With a different personelle, the use of cocaine may be necessary at the initial introduction of the catheter.

To properly pass the instrument over the incisor ridge at the nasal vestibule the tip of the nose should be elevated, as far as it can be done painlessly. The pressure is exerted with the thumb of the left hand, while the catheter, warmed and oiled, is held by the right hand perpendicularly before the mouth, with the concavity of its curve toward the upper lip as illustrated in Fig. 107.

The rounded nozzle of the beak is now introduced through the vestibule, the conical end raised until the catheter is nearly horizontal and, in this position, the instrument is moved very gently along the floor of the nose until its beak slides over the downward slope of the soft palate into the pharynx. The conical end is then rotated almost half a complete turn so that the guiding ring first points to the cheek upon the side under examination and comes to rest pointing to the outer canthus of the corresponding eye. By this manœuver the beak which was directed downward takes a position with its point presenting upward and away from the median line. It is just in front of the cartilaginous lips of the Eustachian tube and slight pressure causes it to enter the aperture. As the curve of the catheter has now an upward inclination, its further movement along

FIG. 107.—Passage of Eustachian catheter. The tip of the nose is elevated and the point of the catheter enters the vestibule.

the nasal floor will increase the distance it penetrates the tube. The patient aids the entrance of the beak by swallowing at the moment it reaches the orifice and its enclosure by the Eustachian labia transmits through the catheter to the directing hand a peculiar sensation, easily recognized by those who have had experience. One new to the work may fail to interpret this sensation and not feel sure that the procedure has succeeded until he has the proof furnished by inflation which is accomplished as follows: The left hand releases the nasal tip and keeps the catheter steady, holding it between the thumb and forefinger, while resting the other fingers upon the bridge of the nose; the right hand grasps the Politzer bag, fits its nozzle into the hollow cone of the catheter and then by compressing the bulb sends a blast of air through catheter and tube into the tympanic cavity, its arrival there being indicated by the sounds heard with the aid of the auscultation tube, just as in the Politzer method.

It is proper to begin invariably by gentle compression of the air bag and to use more force only as required by resistance encountered. Such resistance can be estimated with the catheter better than by the air-bag inflation alone, because the draft impelled to the tympanum reaches only one ear and has less opportunity to escape in lateral directions. In fact, it has considerable impulsive and divulsive power and if, after repeated attempts, no air reaches the tympanum, the conclusion is obvious that there is stenosis of the Eustachian tube, a morbid condition in which the catheter plays a part in treatment as well as in diagnosis. To make the examination of the middle ear complete, it is necessary to take into account abnormalities of the nose and pharynx, both structural and functional. They are important causal factors in aural disease and are necessarily included in a thorough diagnostic study.

The next stage in aural examination is the measurement of hearing or the estimation of the perception of sound. This is also called functional examination, because it is concerned with physiologic acts, either normal or impaired. The internal ear,

the perceptive mechanism, is hidden from view; morbid changes in its anatomy are (while the organ is unmutilated) known to us by inference only, and we are deprived of the aid given by the direct physical examination of the structures. This is a great drawback in both diagnosis and therapeutics and puts otology to a disadvantage suffered by few of the other specialties. Acoustic tests are used to determine the quantity, or loudness, of sound and also its quality. By the former we learn whether the hearing falls below the normal standard and the extent of that deterioration; from the latter we draw inferences as to the part of the ear whose function is impaired. Quantity, which depends not upon the number of vibrations but upon their intensity, is the measure of the audition or hearing power. This power may be ascertained by using a resonator, which accurately produces and records quantities, beginning with a slight resonance and successively magnifying it through a sufficient scale of augmented intensities. When the audition of a defective ear is to be measured, the resonator adjusted for the smallest quantity is placed at the normal distance; that is the distance at which it is just audible to the normal ear. Of course it is inaudible to the defective ear being tested. Increasing power is then applied and the resonance continuously magnified until it becomes audible to the defective ear. This resonance recorded upon the scale expresses the amount of defect or impairment of the ear under examination and inversely the amount of hearing which remains. This balance of functional power is expressed by a number and as it is always less than normal, the number is always a fraction. The numerator is one and the denominator is the number shown on the scale when the magnified resonance became audible to the defective ear, *e.g.*, if it was necessary to magnify the resonance sixteen times before it could be heard, the fraction would be one-sixteenth and would signify that the tested ear retained one-sixteenth of its normal hearing power.

In some respects this method of measuring the functional power of the ear is the best possible; it is easily understood,

requires hardly any mathematical calculation and yields results which are accurate and trustworthy. Nevertheless its use is restricted to the laboratories of physicists and physiologists. In otologic practice its advantages are counterbalanced by a practical objection, the difficulty of securing a mechanism which will produce and record the various quantities in a satisfactory manner. Instruments, or rather machines, for this purpose have been invented and some of them display remarkable ingenuity in construction and attain great accuracy in producing and recording the vibrations, which serve as a means of measuring auditory power; but these machines, like many other contrivances employed in acoustics, are difficult to make and are quite expensive. Because of their elaborate construction and delicacy of adjustment they are easily put out of order and are not well suited to the usual conditions of medical practice.

For these reasons quantitative tests in otologic work are very rarely made by the direct method of magnifying the resonance; instead of this, the usual method employs a resonance of unchanging intensity which can be obtained from several kinds of resonators which are simple and inexpensive. This plan is based upon the acoustic principle that quantity varies inversely as the square of the distance between the resonator and the ear, and as quantity is the measure of audition or hearing power, this also is computed upon the squares of the distances from the resonator to the ear. A resonator of unchanging power is tried with a number of normal ears to determine the greatest distance at which they can hear it. The average of these distances is called the normal distance and is expressed in units of length, such as feet or inches. The distance at which the same resonator becomes audible to the defective ear is measured and expressed in the same units. Remembering that the greater the defect in hearing, the greater must be the quantity to offset that defect, we can calculate the proportion of hearing power which still remains. If, for example, we take the same case as that used in the direct quantitative test already given, we have the following figures: normal distance,

twenty inches; distance for defective ear, five inches; square of normal distance, 400 inches; square of distance for defective ear twenty-five inches; therefore, the hearing power will be $^{25}/_{400}$, or, by reduction, one-sixteenth. This power may always be expressed in a fraction whose numerator is the square of the distance between the resonator and the defective ear and whose denominator is the square of the normal distance.

This method is in nearly universal use, for it is easy to alter the distances between the ear and a resonator of unchanging power, which can be readily procured; while, as has been remarked, the other method in which the distance remains constant and the resonator has varied intensities, requires elaborate and expensive apparatus; but the plan so commonly followed is not free from objection. The calculation introducing the squares of numbers expressing distances has confused the minds of some authors, as is proved by the mistaken statements found in several well-known text books. The authors of these works direct us to express the hearing power by a fraction, using the measured distances, not the squares of those distances. In the illustration already used, the erroneous method of these authors gives the audition as five-twentieths or one-fourth, when in reality it is only one-sixteenth, quite a serious error; for one-fourth audition expresses marked hardness of hearing, which is still compatible with work in many occupations, while one-sixteenth is only a small remnant of the function near the boundary line of entire deafness. The errors arising from this fallacious calculation are so great that it is hard to see how an otologist can go on treating a patient for many days or weeks, without discovering that his diagnostic determination of the hearing power was very far wrong.[1] Such a discovery should

[1] One unfortunate result of such mistakes is their effect upon suits for damages, in which it has been proved that the plaintiff's hearing was injured through the fault of the defendant. In fixing compensatory damages the jury accepts the expert's testimony as to the degree of disability. If one of these authors is the expert, or if his book is accepted as authority, the plaintiff will be adjudged to have far less disability than he actually suffers and a gross injustice will be done to him, because the "expert" professor went astray regarding a familiar law of acoustics.

bring to light the fault in the calculation and result in the author's correcting the misleading instructions given in his book; but years go by, edition follows edition, and yet the glaring mistake remains to misinstruct students and to confuse physicians. We can hardly escape the unpleasant conclusion that these eminent authors have not compared their published statements with the facts of their own actual experience, though this is the confident claim made for the value of their books. They are professors and one cannot help wondering whether their college lectures also are divorced from the realities of otologic practice.

In the routine of daily work most quantitative tests are made with a tuning fork, a watch, or the voice, of which only the tuning fork has a standardized resonance and even with it allowance must be made for certain discrepancies. If absolute accuracy were to be attained, the apartment used for aural tests would require entire silence, just as that employed for scientific experiments in photometry requires facilities for producing total darkness. Our actual environment is very far from such a condition. In selecting an office, it is seldom that any attention is given to the acoustic properties of the room, its production of echoes and nonvibratory centers due to the counteraction of acoustic waves; yet these properties have an influence upon the tests, in some rooms a decided influence. There are also the noises produced by movements outside of the room and even of the building; "the city's ceaseless, complex hum;" and these too are factors in the composite oscillation enveloping both patient and physician and modifying the results reached in the examination. In consequence of these conditions, each otologist must work out for himself a method whose chief factors are the power of the resonator and the square of its distance from the normal and from the defective ear, while its minor factors are peculiarities of room, house and street. If he keep steadily in view the acoustic laws bearing on the subject and observe and appreciate all the peculiar features of his environment, he will develop a technique which will yield satisfactory results. They will not reach mathe-

matical accuracy, but will furnish all that is necessary to determine the approximate degree of disability and—what is more frequently needed—a correct guide for treatment. The variation from perfect accuracy is, in good practice, rarely more than five per cent.

The tuning fork best adapted to quantitative examination is one of low pitch, about 200 V.D. Overtones which are numerous in forks for this part of the register should be eliminated, either by clamps or by the way in which vibration is excited. The normal distance of the fork having been ascertained by averaging a number of observations made in the special environment of the otologist, this distance and its square should be recorded either on the fork itself, or on the shelf where it lies. The distance for the ear under examination is ascertained by causing the fork to vibrate, when held horizontally with the tines pointing to the ear, and then advancing it from the normal distance (where it is inaudible) to a station where it is heard. The distance separating this station from the ear and the square of this distance are entered in the record of the examination. It is very desirable to compare the results of the fork test with those given when other resonators are employed.

The tick of a watch produces two sounds, both of which are impure tones occasioned incidentally by the time-recording movement, without any design that they should serve any otologic purpose. Nevertheless, the watch, which was the first mechanical resonator used to measure the audition, holds its place on account of its convenience. The normal distance for the watch devoted to this use should be ascertained, as was done for that of the tuning fork, and this with its square should be recorded inside the case, so as to be always available. In testing impaired hearing, the watch should be advanced from the normal distance to a station where the tick becomes audible to the defective ear. As with the tuning fork, it is better that the resonator should find its station by approaching the ear than by receding from it.

Testing with the human voice, while liable to many fallacies, has a feature of great value in the fact that the ability to hear speech is beyond all comparison the most important phase of the auditory function, and the ratio in which this ability is retained is often somewhat different from the ratio applying to other sounds. The voice can be standardized by the phonograph which gives reproductions of unvarying character as to both quantity and pitch. Most examinations are made by direct use of the physician's own voice, employing in vocalization only the reserve air which remains in the lungs and bronchi after an expiration. The vocal vibrations caused by this remainder are much less variable than those excited by the stronger current passing through the larynx in the usual expiratory act.

In using words as a test, it must be remembered that certain letters of the alphabet represent more quantity than others, irrespective of phonatory force applied by the speaker. According to Blake's table, T has the greatest intensity and M the least. Furthermore, familiar words and sentences must be avoided to eliminate the influence of mental suggestion which, when a few sounds are actually heard, supplies what are lacking by the laws of association. A quick-witted patient often makes correct guesses regarding what is uttered by watching movements of the oral muscles, even without any special training in lip reading, hence the speaker's face should be averted. The relations of distances to quantities are just the same in tests with the voice, as when use is made of mechanical resonators.

While the ordinary clinical requirements of quantitative examination can be met in the ways just described, it is proper to mention a set of resonators which has attracted attention in all countries and has excited much interest in the United States, as is shown by a large importation, in spite of a high price (about $200). These instruments are capable of producing all the rates of vibrations audible to the human ear and most of them have a constant, invariable intensity.

They are designed for both quantitative and qualitative tests and, being strong and durable, are free from the objection to the machine resonators that are hard to keep in order. The set comprises seventeen pieces: fourteen forks, two closed organ pipes and one whistle, and is the joint production of Bezold and Edelmann, the former a professor in the University of Munich and the latter an instrument maker of the same city. In determining the existence of the so-called islands of hearing remaining in the cochlea, when much of its function has been lost, this complete set of resonators is invaluable and each separate instrument appears to have great excellence both as to mathematical accuracy and mechanical workmanship.

Qualitative tests, conducted with graded tuning forks and the Galton whistle (Chapter III), determine the perception of pitch and their main value arises from the fact that diseases of the external and middle ear interfere more with the low tones, produced by the slower vibration than with the high tones caused by more rapid vibration, while diseases of the internal ear have a precisely contrary effect, damaging the high tones more than the lower ones. Therefore when by quantitative tests we have determined the defect existing in the function, qualitative examination will guide us in searching for the lesion responsible for impairment; if hearing in the lower register has suffered most, we conclude that the conducting apparatus is at fault; if the main failure is shown in the upper tones, there are morbid changes in the labyrinth.

Rinné's tests are positive and negative. In the first, a vibrating tuning fork is set upon some spot in the median line of the skull and kept there until it becomes inaudible. Without being again struck, it is held close to the meatus of the ear under examination. If in this position there is resurgence of the sound, it is concluded that the acoustic integrity of the conducting apparatus is maintained, though various morbid processes may affect some parts of the external or middle ear. In the second or negative test the vibrating fork is first held close to the external meatus and, when it

becomes inaudible, is transferred to the median line of the skull. If in this position the fork is heard, the result proves that the conducting apparatus is in a morbid condition. The conclusions reached by Rinné's tests are vitiated if there is disease in the middle ear and also in the labyrinth.

The Weber test for bone conduction is made by placing a vibrating fork (about 256 V.D.) at different points upon the cranial median line and observing whether it is heard better in the normal or the defective ear. In the former case the lesion is in the labyrinth because the internal ear on both sides is generally accessible to bone conduction and therefore the better organ yields the better perception, but in the latter case, where audition is better in the impaired ear, the lesion is in the external meatus or in the middle ear, because air vibrations are partly cut off on that side and do not interfere with the labyrinth which is exclusively affected by the osseous vibrations and hence perceives them more acutely than the labyrinth on the other side, although both are normal.

In the Gardiner-Brown test, a lightly vibrating fork is placed upon the bridge of the nose and the surgeon notes how long the tactile sense in his fingers can recognize the vibrations and if they cease at the same moment that the fork becomes inaudible to the patient. Normally the cessation of the two sensations is simultaneous and if the hearing stops first, there is a diminution in the bone conduction or a lesion in the internal ear. This test is made in another way by placing the fork upon the patient's mastoid process and at the moment it becomes inaudible transferring it to the mastoid of the surgeon. If he hears nothing, he judges the patient's bone conduction and labyrinth to be normal, but if the fork is audible to him either the osseous transmission or the perception is impaired. It is obvious that this form of the Gardiner-Brown test presupposes that the surgeon's ear is in a perfectly normal state. There is also a chance for error in both forms of this test because the bone conduction notably decreases after the forty-fifth year and, if the ages of patient

and surgeon are upon different sides of that line with a considerable interval between them, the conclusions as to disease are likely to be vitiated.

Comparative observations of bone and air conduction have recently so largely engrossed attention that a test of the middle ear devised by Politzer, years ago, has fallen into partial disuse, but it is still much esteemed by several high authorities. The procedure is simple: a fork of low pitch (about 256 V.D.) is thrown into strong vibration and held close to the nostrils; the intensity is observed and then the patient swallows, by that means opening the Eustachian tubes. If the tubes and tympana are free from obstruction and suppurative or hyperplastic changes, the sound is notably louder during the moment of deglutition, when the intratubal column of air vibrates, but if the obstacles mentioned are present, then the sound is fainter because deglutition vibrations interfere with those taking the circuitous route over the cheeks to the external meatus. By repetitions this test gives quite accurate information regarding the comparative condition of the middle ear upon the right and left side, both as to the patulency of the tubes and the normality of the tympanic cavity.

CHAPTER XXIX

THE EXTERNAL EAR: DEFORMITIES AND DISEASES

Anatomically described (Chapter XXVII), the external ear includes the auditory structures outside of the membrani tympani, or drum-head. These structures are not infrequently the site of deformities, either congenital, developmental, or traumatic. Many of these are merely disfigurements which do not impair the auditory function or injure the general health. They cannot for these reasons be ignored as trivial, for sometimes they are very unsightly and inflict mental distress greater than would be caused by even marked dulness of hearing which is unilateral. Caleidic operations ingeniously adapted to individual conditions have done much to ameliorate these disfigurements; they are within the legitimate province of caleidic surgery and should not be turned over to tradesmen outside of the medical profession. There are other deformities which are not only unæsthetic, but injurious to the hearing and to the constitutional health, directly or indirectly. Such obviously require our attention.

Atresia of the meatus, when congenital, is apt to be associated with a rudimentary condition of the ossicles and with absence of the membrana tympani. In such cases the closure of the canal serves to protect the tympanic structures which would otherwise be exposed, and it is best not to interfere with the abnormality unless the occurrence of suppuration in the middle ear makes such action imperative. This congenital atresia impairs hearing less than would be expected. Children with such deformity learn to speak and subsequently functionate reasonably well.

Acquired atresia may result from traumatism, but is commonly a sequel of long-continued inflammation causing thick-

ening of the cartilage and the fibrous tissue. As otitis media is very often coincident with the occlusion of the canal, it becomes necessary to restore the lumen of the meatus for the sake of drainage and to secure access to the middle ear. The hyperplastic tissue may be softened and absorbed under several weeks' treatment by electrolysis, the negative electrode being used with a partly insulated needle at various points along the interior of the canal, while the positive, inclosed in a large sponge, is applied over the thick muscles of the back or shoulder. A galvanic current is employed upon alternate days for ten or fifteen minutes at a time. When the constriction is caused by annular bands, these may be divided at two or three points in their circumference and dilators used to keep the canal fully open until granulations fill the spaces left by the incisions and the normal lumen is restored. The meatus is sometimes obstructed by bony growths whose cause is obscure, and they may obtrude somewhat without causing any symptoms. The term exostoses is applied to those appearing as white nodules of spheroid shape, sometimes pedunculated, while hyperostoses are diffuse, sessile growths upon the lower wall of the canal. When inactive and innoxious these enlargements should not be disturbed, but when they are extending so as to interfere with drainage or to impair the hearing, they should be extirpated by incising and retracting the integument and then removing the superfluous bone with chisel, gouge, or forceps, care being taken not to injure the walls of the canal.

Appendices are abnormal extensions of the cartilage of the auricle. They nearly always appear in front of the tragus which is smaller than natural and sometimes rudimentary as though the cartilage had grown in the wrong direction. Such an anomaly is properly removed by dissecting back the overlying skin, excising the cartilage and bringing the edges of the wound into neat coaptation.

Fistula auris is a congenital deformity consisting of a pouch, located in front of the tragus, and having an interior lining

formed of invaginated skin. At the point where this reflected integument joins that outside there is an orifice leading to a short canal that when inflamed becomes the fistula from which the condition takes its name. The irritation of this tract and consequent suppuration is due to desquamation of the epithelium of the invaginated skin. This process seems to remain in abeyance for long periods during which the abnormal pouch gives rise to no symptoms. Then desquamation occurs, the cast-off epithelium cannot escape, it undergoes decomposition, produces capillary congestion by pressure and pus is formed. When this takes place, the only satisfactory treatment is extirpation. The fistula is explored with a large probe and then slit throughout its length with a straight bistoury; all the contents are turned out and the dermal lining removed with a curette. The denuded surfaces are then rendered aseptic, brought together and retained in apposition by adhesive strips or sutures, so that the healing process shall obliterate the cavity.

The auricle, from its exposed position, is liable to traumatism of many kinds. In general the treatment required is that applicable to wounds in other parts of the body, with modifications due to peculiar anatomical features. As the cartilaginous framework is covered by the skin with very little interposed muscular tissue, contusions are especially liable to give rise to hæmatomata, the extravasated blood lacking the normal pressure exerted by the muscles. So, too, lacerated wounds of the thin plate of cartilage and skin require special care to secure and maintain proper coaptation of the edges, because the structure has little inherent tonicity.[1] The ex-

[1] Traumatism, as seen in our day, is nearly always the result of accident. The intentional cutting or tearing of the auricle is now rare, but was common in times not very remote, when physical mutilations were punishments inflicted by the courts of law. As late as the colonial period of our own country, the penalty for certain crimes was the amputation of one or both ears. That barbarism is nearly obsolete, but a vestige remains in the mutilation of the auricular lobe to suspend a ring or "ear-drop." In the last generation this was a common practice, not by the behest of law, but by the mandate of fashion.

ternal ear is liable to two injuries which frequently occur in disasters, such as the fall of buildings, railroad wrecks and serious accidents caused by machinery. The first is fracture of the meatus. The canal may suffer rupture in either its cartilaginous or bony section and the injury may be caused by either direct violence or by indirect force (counter-stroke) transmitted through the contiguous tissues. The symptoms are variable. The pain felt at the moment of injury is often confused with other suffering due to the accident. Bleeding sometimes occurs. Subsequently there is apt to be tenderness, giving rise to pain due to strong vibrations when loud sounds are heard but the diagnosis can be established only by careful inspection with the speculum and exploration with a blunt probe. The chief factor in treatment is physiological rest. Syringing may do harm and should be avoided but discharges, if they occur, can be carefully wiped away and the cleansed surface treated with a saturated solution of boric acid, employing for both objects a small cotton-tipped applicator. Between treatments a sterile dressing should be kept over the entrance to the injured meatus and, as far as possible, the patient should be protected from loud noises.

The other traumatism is most frequently caused by rapidly moving machinery and especially by driving belts transmitting motion between swiftly rotating wheels. If the hair becomes entangled in such a belt the soft parts from the vertex to the angle of the lower jaw may be torn loose and either wholly severed or left hanging as a great, ragged flap bearing the

It is still prevalent among the peasants of some countries, as anyone may see who looks at a throng of recently arrived immigrants. Another relic of the old brutality is the cuffing and jerking of the auricle to punish children. Pain can be inflicted in a score of ways which do no permanent physical harm to the culprit, and yet many parents with amazing stupidity twist the auricle or subject it to sharp blows. Since it is their own offspring with whom they deal, they can use methods which the law forbids to the schoolmaster. This cruel and senseless practice has done untold injury to the delicate aural mechanism of children and is responsible for partial deafness in thousands of adults who were subjected to it in their early years.

entire auricle and with it part of the meatus. To replace this flap and secure proper coaptation is difficult; even when union is secured the auricle is apt to be out of place. The resulting atresia of the meatus is often unimportant for usually the injury wholly destroys hearing on that side. If an effort is made to restore the canal a cruciform incision must be made through the flap and an opening maintained by cotton or other plugs till its margin heals.

The auricle is not likely to shelter foreign bodies but they find their way into the meatus in great variety, both as to shape and substance. The seeds, pebbles, buttons and other inanimate extranea owe their introduction to the fondness for experimenting on their own bodies, which is very strong in many children. Once in the meatus, the article may remain because the child cannot get it out, or because it is forgotten. The ears of the insane and the feeble-minded become receptacles of odds and ends for similar reasons. Curiously enough, the ultimate damage consequent upon this misuse of the meatus is due less to the immature and defective than to the adult and rational people; for these extranea seldom do much harm to the walls of the canal or to the aural function, but very serious injury often follows harsh and unskilled attempts to remove them, and these attempts are made by those who are mature and presumably rational. There is so much danger in rough-and-ready methods of extraction that it is not superfluous to caution even the physician. The safe course is to depend upon the syringe and water at the temperature of 100° F. to loosen the foreign body, when patient and careful manipulation will alter its position sufficiently to afford a crevice for introduction of the blunt hook, with which it can be dislodged.

Animated intruders are sometimes found in the meatus; much more frequently in tropical countries than here. The ova of insects are deposited in the canal, either beneath the skin or under a layer of the cerumen and the insects themselves are sometimes held fast by this tenacious substance. They are

usually dead when found, but sometimes remain alive for many hours causing much alarm by the noise they made, a noise which sounds loud in the confined space of the meatus. These intruders should be killed by instilling a little chloroform, or kerosene, and then dislodged by a jet of water. If after thorough use of the syringe the patient still thinks something is moving in the canal the meatus should be loosely packed with absorbent cotton saturated with mucilage of acacia and the plug retained for several hours. Any insect living or dead will be entangled in this adhesive mass and come with it when it is taken out, as will also any eggs deposited upon the dermal lining of the canal. The mucilage is quite harmless and any of it which remains is easily washed away. A meatus which has harbored any living thing should be kept under observation for a short time to make sure that any larvæ produced from ova deposited under the epidermis are found and destroyed. A repulsive form of insect intrusion is seen in neglected children, suffering from chronic, purulent otitis media ("mutton ears"). Pus accumulates in the concha and drips from the lobe, attracting large numbers of insects, which deposit their eggs in all parts of the external ear. Thus the meatus becomes infested with maggots which emerge from it and crawl over contiguous surfaces—a disgusting sight! The entire locality should be thoroughly sprayed with nebulized chloroform. This kills the larvæ: their reproduction must be prevented by keeping the auricle clean and removing pus from the meatus as rapidly as it collects.

Ceruminous accumulations are intermediate between extraneous obstructions and disordered secretions, showing features of both. The cerumen, or ear-wax, is a physiological exudate of sub-dermal glands but it often becomes thick and inspissated, forming a firm plug which fills the lumen of the meatus for variable distances. If the accumulation reaches to the tragus it is observed and the dangerous ear spoon employed to remove it, but when the impaction is limited to

the deeper parts of the meatus it often escapes notice until some impairment of hearing leads to a medical examination. Aural examinations (for insurance, for occupations and other purposes) often bring to light plugs of inspissated cerumen, which nearly fill the deeper section of the canal and which have existed for a long time but have not affected the hearing. These facts and others lead to the conclusion that, as a rule, such accumulations have little effect upon the function of the ear; but there are many exceptions.[1]

In some cases impacted ear-wax may be removed by directing against it jets of hot water, 115° F., impelled by a syringe. If, however, the plug is much hardened, this is a tedious procedure and it is better as a preliminary to soften the mass in which there are often beside the cerumen, epithelial scales, dust and detritus of various sorts. This softening may be effected by a solvent liquid like the following:

℞. Sodii bicarbonatis..... gr. xx
Glycerini..... fl. ʒj
Aquæ.....q.s. ad. fl. ʒj. M.

This should be instilled with a dropper to thoroughly moisten the impacted mass and, when the fluid has been absorbed more should be added at intervals, until the plug becomes pultaceous. The mass is then washed away with the water jet and the interior of the meatus thoroughly dried with a cotton-tipped applicator. Ear spoons and similar implements often do much harm; they certainly should not be used in any case by unskilled hands. After the removal of

[1] A man of twenty-five, a clerk in a railroad office, suffered rapid deterioration of hearing; six weeks after he first noticed the defect he had become unable to understand general conversation. On account of some prejudice he was averse to seeking medical aid but at last, in fear of losing his employment, he consulted a specialist. Each meatus was clogged by a sort of compost—dead epithelial cells, dust and inspissated cerumen—the whole being impacted into a firm mass which proved hard to soften. When the entire accumulation had been removed the man's hearing was found to be normal in both ears. Such a case is exceptional but may occur any day. The cure however easy is very impressive to the patient and to overlook this condition and follow a wrong course of treatment is very unfortunate.

a large ceruminous plug, the meatus may be sensitive and irritable until it becomes accustomed to contact with the air long shut out. This condition is relieved in a few days by liquid petrolatum applied upon a pledget of cotton.

The other morbid states of the external ear are classed as diseases, nearly all of an inflammatory type. Of these eczema is the most important, on account of its prevalence and the intractable character it shows in this locality. Two-thirds of all cases of disease of the external ear are referable to eczema, in one or another of its protean forms, nearly all of which may be either acute or chronic in their course. Eczema erythematosum is characterized by redness, swelling, and slight scaling, with itching and burning; eczema papulosum by great numbers of minute, acuminate papules and severe pruritus; eczema vesiculosum by numerous small vesicles upon a patch of congested skin, very itchy and tending to rupture, leaving a raw, weeping surface, soon more or less covered with desiccating crusts; eczema pustulosum by aggregations of pustules, breaking down and discharging their contents which form thick yellow scabs. These four kinds of eczema may be regarded as progressive manifestations of a diseased process which shows successively, congestion, papules, vesicles and pustules, but in any particular case some part of the process may be slight and hardly noticed. Eczema squamosa is a variety distinguished from the erythematous form by the rapid separation of large scales. Eczema rubrum is secondary to pustulation and is characterized by large circumscribed areas, whose surface is raw, moist and of a dark red color, these patches being ultimately covered by thick crusts.

Pathologically, eczema begins with general vascular congestion of the cutis and sub-cuticular tissues which is followed by serous infiltration of the dermic layers and in chronic cases of the connective tissue. The serum exuded upon the surface has undergone changes, which make it an irritant, and it excoriates sound skin over which it flows and excites the formation of pus. What alteration occurs in the plasma of

the blood is not determined; many believe it to be the same which takes place in persons of the rheumatic diathesis, but the primary conditions are obscure. Poor hygienic surroundings and uncleanly personal habits have a place among predisposing causes as also has suppuration near-by, as in otitis media. Auricular eczema is at times an extension of the disease from the face or scalp. Exciting causes include injudicious scraping with the finger nails or instruments, maceration from the prolonged use of warm, damp dressings, and the pernicious mutilation of the lobe for the suspension of jewelry. Although eczema of the external ear is usually more obstinate than the affection in other regions and proves particularly intractable when located upon the folded skin between the auricle and mastoid process, yet the prognosis is favorable if the patient will, for a sufficient period, follow faithfully a judicious plan of treatment which is adapted to peculiarities both of the individual and of the locality affected.

The first step in treatment is to counteract the influence of any etiological factors that may be under our control. Ornaments must be removed from the auricular lobe and their replacement positively forbidden; the drum membrane must be examined for perforations and, if any are disclosed, they must receive proper attention; suppuration must be appropriately treated and even when there is no discharge of pus the meatus must be kept sound and clean by daily irrigation with a saturated solution of boric acid, followed by drying with a cotton-tipped applicator. The rhagades, which are apt to be found behind the auricle, where the inflamed skin has been wounded by rough handling, must be cleansed and dried with great gentleness and touched with a solution of silver nitrate of a strength of sixty grains to the fluidounce and then dusted with pulverized boric acid. Crusts and scabs when loose, are lifted with dressing forceps; if adherent they are covered with ointment of zinc oxide, which is left on over night; in the morning they will be much softened and are easily removed; the denuded surface, if there are vestiges of pus, is cleansed

with a cotton swab steeped in a mixture of hydrogen peroxide and water, its strength being sufficient to decompose all pus but not sufficient to check granulation, which it is our purpose to encourage. The clean surface is then dusted with a powder made of equal parts of zinc oxide and boric acid. When great discomfort is caused by the pruritus the skin should be lightly rubbed with a powder made by mixing intimately twelve grains of pure phenol with one dram of calomel and three drams of talcum powder. In addition to the local treatment here advised, attention must be given to the general health. Indiscretions in eating and drinking must be avoided with sedulous care, and even greater watchfulness must be practised to prevent constipation which in many persons greatly aggravates the symptoms. Some patients are benefited by the exhibition of the alkalies, particularly the salts of potassium and strontium, and others derive advantage from iron, probably through its influence upon the red corpuscles of the blood. There is a form of dermatitis, symptomatically identical with eczema erythematosum, which follows continuous use of iodoform, in persons who have an idiosyncrasy regarding the iodine compounds. It disappears in a variable time after withdrawal of the medicine and should any effects persist, they must be treated as though sequels of the idiopathic affection.

Furunculosis occasionally occurs at the orifice of the meatus originating in the follicles of the hairs, which are in some persons very abundant at that place, and causing redness, heat and tenderness. If the morbid process is only slightly advanced, so that resolution is possible, a cure can be effected by introducing, apex first, a conical plug of cotton smeared with this ointment:

℞. Hydrarg. oxidi flavi..... gr. ij
Adipis lanæ hydrosi (lanoline)..... ʒiij
Misce et fac unguentum.

If morbid action has gone far enough to cause pustulation in some of the follicles, the hairs must be extracted from

those thus affected and the pus evacuated. If a little purulent fluid remains, keeping up irritation, it may be readily decomposed by injecting with a blunted hypodermic needle a drop of hydrogen peroxide by way of the vagina pili, emptied by the extraction of the hair.

Herpes of the auricle is a rare disease and the severe neuralgic pains which accompany it may be attributed to something else; but close inspection of the vesicular eruption will establish the diagnosis. The cutaneous lesions are the same as in herpes zoster and the neural pathology is similar. The constitutional treatment applicable to the more common form of the affection should be followed in the auricular variety. Topical measures are palliative and do not shorten the course of the disease, but they lessen the patient's discomfort. Sedative lotions and ointments may be applied over the affected skin and small hypodermic injections of morphia may be required during exacerbations of the neuralgia.

Perichondritis is an inflammation of the membrane which covers the cartilage and separates it from the skin. It may affect any part of the auricle except the lobe, but the tragus is most frequently involved. Its etiology includes traumatism (often the parental cuffing and wrenching already referred to) and extension of morbid action from adjacent parts, particularly the meatus. The lobe being destitute of cartilage is exempt. The disease begins with congestion of the perichondrium, signified by vivid redness of the overlying skin and by great tenderness. As soon as serous effusion takes place, swelling supervenes, often to an extent which alters the contour of the affected part, and the coincident pressure causes acute pain. With the formation of pus occur the familiar symptoms, general and local, associated with pyogenesis. If "left to nature" perichondritis tends to spontaneous recovery, ulcerative perforation of the skin causing the formation of a sinus, or more commonly several, through which the pus is gradually discharged, and cicatrices ultimately close the openings. These so-called "natural cures" are very

unsatisfactory. The patient suffers much and long from a running sore, incurs the risk of the spread of purulent infection and finally has auricular deformity more disfiguring than the knife's worst results.

If treatment is instituted at the very start, the congestion may be overcome by the auricular bag of crushed ice, aided by the administration of saline purgatives and aconite. When effusion has taken place the liquid must be withdrawn. The use of the aspirator, supposedly scarless, is a concession to the fears of a patient who thinks the knife will disfigure her ear and if we are sure that the pulsating liquid is serum only, aspiration is justifiable: there are reports of both its success and its failure. When pus is present in perichondritis the aspirator does not remove it thoroughly. This is the consensus of opinion and there should be no delay in penetrating the cavity by an incision large enough to insure complete evacuation of all the contents. Subsequent treatment should be that required by any pyogenic cavity. Curettement is needed in cases of delayed healing and in every instance aseptic conditions of the incision and the surrounding parts must be maintained by a light, sterile dressing, which protects the auricle without exerting any pressure.

An othæmatoma is a tumor caused by extravasation of blood between the perichondrium and the cartilage of the auricle, where it appears as a fluctuating mass of convex shape and bluish color. It is nearly always of traumatic origin and may complicate an attack of perichondritis; but there are exceptional cases lacking such causation, in which the othæmatoma may possibly be due to some lesion in the nerve centers. When the tumor is of a noninflammatory character, absorption may be induced by daily paintings with tincture of iodine, massage and a dressing making moderate pressure. The failure of these measures after fair trial is an indication for subjecting the tumor to the operation performed upon the hæmatomata in other parts of the body. An incision is made to allow the evacuation of the contents, the lining of the cavity is irri-

gated antiseptically and the opposite surfaces are coaptated and held in place by an efficient dressing until they unite. Patients should be warned that some disfigurement is liable to remain despite the best treatment; for the auricle may be affected with chondromalacia making the cartilage so soft and weak that it cannot be retained in the normal position during the healing process.

Abscesses developing in the course of an attack of perichondritis are merely local exaggerations of processes occurring during the purulent stage of the disease and should be treated accordingly.

Otitis externa diffusa is an inflammation of the lining membrane of the external auditory meatus and has the usual symptoms: heat, redness, swelling and pain. The tumefaction is often marked and renders examination with the speculum quite difficult; this feature also affects the movements of the lower jaw, as the muscles are stiffened by the surrounding infiltration and motion becomes painful, so that the patient is reluctant to take food which requires chewing; aside from this source of pain, the disease is attended with considerable suffering which may require the administration of sedatives. The hearing may or may not be dulled by the encroachment of the swelling upon the lumen of the meatus; but it is decidedly affected, when the cutaneous layer of the drum-head becomes involved, as it does in nearly half the cases. This form of otitis is caused by the bacillus pyocyaneus whose presence is demonstrable by bacteriologic tests. There is also a peculiar feature in this inflammation which aids in distinguishing it from those produced in other ways; this peculiarity is the absence of pus; the other phlegmonous symptoms are present and frequently severe, but pus is not exuded spontaneously nor is it brought to light by an incision. The etiologic germ appears to have the power of repelling the leukocytes so that the usual process of inflammation stops short of purulent effusion. The disease commonly terminates spontaneously in three or four weeks but is apt to recur.

The most efficient remedy is a five per cent. solution of silver nitrate which, acting as a germicide, extirpates the cause of the disease, and also by its causticity promotes exfoliation of devitalized tissue. The application should be made with a cotton-tipped probe to the diseased surface and repeated, at intervals, until desquamation is complete.

Otitis externa crouposa has the same etiology as the variety just described, from which it differs in producing a pseudo-membrane covering the interior of the meatus; the envelopment

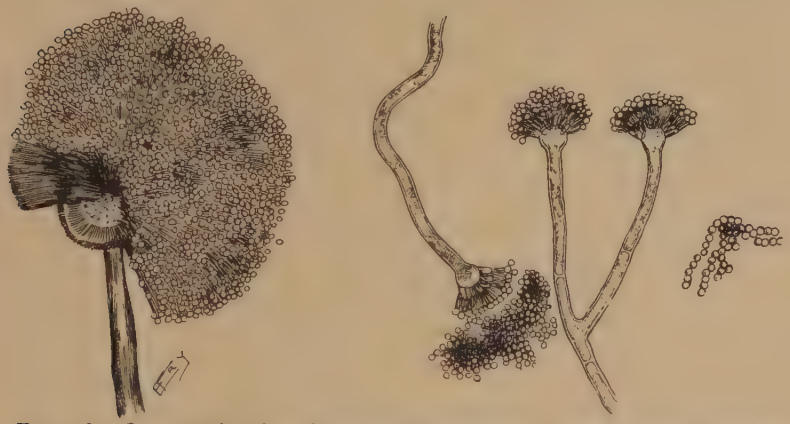


FIG. 108.—Otomycosis. Greatly enlarged illustration of fungus, aspergillus niger. (*Knight and Bryant.*)

may be partial or complete and sometimes this sheath is cast off in a single piece, having the shape of a glove finger. The treatment with silver nitrate is applicable to this variety as well as to otitis diffusa.

Otomycosis, accurately portrayed in Fig. 108, is another disease of bacterial origin. It is generally unilateral. A microscopic fungus, or mould, develops upon the lining membrane of the meatus, at first giving rise to few symptoms but when it has encroached much upon the canal, causing paroxysms of pain and impairing the hearing. Through the speculum the walls of the canal show a deposit of scales and flakes of a grayish-yellow color sprinkled with black specks. The

growth of fungi is favored by previous disease and by lack of cleanliness, subjecting the aural membranes to the combined influences of heat, dirt and dampness. When oil has been instilled into the meatus and subsequent cleansing neglected, its remains become a soil most friendly to implanted bacteria. Doubtless, impairment of the general health, by lessening the resisting power of the epidermis, promotes the implantation of these germs which, under normal conditions, would be cast off as soon as they were deposited upon the surface of the skin. Cases of otomycosis, when seen by the physician, are generally at an advanced stage and the congestion and tenderness of the canal call for sedative treatment. A saturated solution of boric acid may be used for daily irrigation and its application followed by insufflation with powdered zinc oxide. When some amelioration of the symptoms has been secured the fungus should be destroyed by an active germicide. The remedy which I prefer is a two per cent. alcoholic solution of salicylic acid instilled drop by drop into the affected meatus, the patient being in the recumbent posture on the other side. Enough of the solution should be used to thoroughly moisten the scaly layer within the canal, and upon the following day the loosened particles should be washed away by a jet from the syringe. Then another layer should be saturated and when loosened removed in the same way, the treatment being continued until the meatus is entirely free from the fungus.

Erysipelas sometimes appears primarily in the auricle, the streptococcus gaining a lodgment in some fissure or excoriation, though it is more frequently an extension of the facial form of the disease; the meatus is often involved and sometimes the membrana tympani; but intracranial infection is rare. Rest and aseptic surroundings are important as they are when the disease affects other localities, and the internal administration of the tincture of iron chloride, ten minims every three hours, has long retained the confidence of the profession. Topical use may be made of folded gauze steeped in lead water and laudanum, or in a twenty per cent. solution of magnesium

sulphate. Obstinate cases and those showing a disposition to recur should be treated with antistreptococcic serum.

Malignant growths upon the external ear are rare and those reported have been remarkable for amenability to treatment, indeed such neoplasms have a better prognosis in this locality than in any other part of the body. Their site is commonly the tragus, whence they extend to the concha, antitragus and meatus, for a long time sparing the membrana tympani, though this is ultimately involved. Like other cancers, they are generally seen in persons past fifty years of age, but in several recorded instances the patients were under twenty. Bezold made a study of a group of these cases, arriving at results which are surprising and almost paradoxical. The neoplasms were classified as sarcomata and epitheliomata, because repeated microscopic examinations left no doubt as to their morbid anatomy. They gave rise to frequent and severe pain and bled when subjected to slight irritation, or even spontaneously. So far they conformed to the description of malignancy which is so familiar; but their other features exhibited contrasts rather than similarities. Their growth was exceedingly slow, extending over years; in very few instances was there any involvement of the cervical or other glands and in none was a cachexia developed. In some of them treated with the Rœntgen rays, there were long periods of quiescence, during which part of the ulcerated area was recovered by skin of normal character. Most surprising of all was the result of operation. In cases where it was possible to remove the growth together with a marginal segment of healthy tissue, excision was performed and in all these cases the patients were apparently cured. During intervals ranging from three to five years, which elapsed between the operations and the publication of the statistics, there were no recurrences. Making every allowance for exceptional circumstances which may have affected results in this group of cases, they still show that cancer is not necessarily beyond remedy and that we may hope to find a curative treatment for malignant disease.

The actual size reproductions given in Fig. 109 are posterior and lateral views of the same auricle. It will be observed that the disease has wholly destroyed the tragus and antitragus together with much of the skin and subjacent tissues along the line of junction of the auricle with the mastoid surface, leaving an elliptical opening three-fourths of an inch long. A probe has been passed through this hole and the notch left by destruction of the tragus. The patient was a widow, sixty-one years of age with good family history and no recollection of any impairment of hearing or any affection of the nose, throat or ear, until five years ago, when a tumor appeared in the auriculomastoid crease and continued to grow slowly and without ulceration for six months. The growth was extirpated. Postoperative healing was rapid and complete, patient remained well for three years, then a blow upon the auricle from a falling chair started a tumor at site of former growth. It developed its present condition in sixteen months. Pathological report, "carcinoma."

European otologists make mention of a dangerous inflammation and necrosis of the external and middle ear voluntarily induced by conscipts who pour corrosive liquids, like the strong mineral acids, into the meatus, expecting that the damage done to their hearing will render them exempt from military service. Their folly sometimes leads to fatal consequences and the facts brought to light by legal investigation prove that this pernicious practice is not infrequent. It is strange that any sane man should choose such a dreadful alternative rather than serve a term of enlistment, and it is disgraceful that regular physicians, graduates of the universities, should, for a small fee, take part in this shameful malpractice, but that also is beyond question. Jürgens reports that four young men, who had been conscripted in Warsaw, poured strong hydrochloric acid into their ears to cause their rejection by the examining surgeon. In agonizing pain they were taken to a hospital. One died of hæmorrhage, two of meningitis and the fourth survived, deaf and partially paralyzed.

FIG. 109.—Lateral and posterior views of carcinoma of the left auricle; natural size; recurrent growth. (*Stout.*)

(*Facing page 342.*)

This pernicious practice seems to be unknown in the United States. It is true that during the conscription in the latter part of the civil war, some drafted men sought exemption by simulating deafness, but their plan was to deceive the examiner, not to injure their ears, and there is no report of any self-inflicted damage comparable to the cases above cited.

CHAPTER XXX

MIDDLE EAR: TUBAL OBSTRUCTION

The middle ear, comprising the tympanum, Eustachian tube and mastoid sinuses (Chapter XXVII), is a complex structure and has certain anatomical features found in no other part of the body. These peculiarities are only partially revealed by dissection, but become obvious in the light of pathological processes. For example the course of what has been called catarrh of the middle ear is different from the course of catarrhal inflammation elsewhere; indeed the order of phenomena is nearly reversed, a fact due to histologic differences. The effort to classify morbid processes, as modified by these unusual structural features, has led to much diversity in the nomenclature of middle-ear diseases as given by the text books in common use.

I believe the otologists of the Munich school are right in teaching, that under the influence of disease the lining of the cartilaginous section of the Eustachian tube acts in a manner similar to that of mucous membranes elsewhere, while the lining of the rest of the tube, of the tympanum and of the mastoid sinuses behaves more like a serous membrane; so that the isthmus becomes a demarcation, with morbid manifestations of a certain kind on one side, and of a different kind upon the other. Viewed in this way, the processes of disease are more readily understood and are separated into those which at the start are inflammatory, and those which are not.

Diseases of the middle ear are very frequent, constituting two-thirds of all aural maladies. This prevalence is due in part to the duality above mentioned and in part to the great frequency with which the exanthemata of childhood affect the tube, tympanum and sinuses. In a majority of cases, these infections

invade some part of the middle ear, though often the involvement is slight and temporary.

Tubal obstruction frequently exists for a considerable time, without attracting attention, until it is disclosed by an examination undertaken to discover the cause of incipient deafness. In other cases it manifests its presence by discomfort and even pain. As seen by the physician it has usually existed a good while and is accompanied by inflammation, but this coincidence is not a necessary association and it is important to ascertain which of the two conditions stood first in the order of time, for in this matter, *post hoc* is also *propter hoc*. It is true that chronic inflammation gives rise to obstruction, but there are obstructions in whose causation inflammation plays no part and if they are seen at an early stage, before there is much interference with drainage and ventilation, they exhibit simple intrusions upon the lumen of the tube, with variations in degree from slight encroachment to remittent occlusion. This type of obstruction is more common than is generally supposed, because secondary or concurrent affections often divert attention from the primary disease. According to Bezold's statistics, more than eight per cent. of cases of impaired hearing have this form of obstruction among their etiologic factors.

The fact recorded by many observers that this condition is far more common in children than in adults, would lead us to suspect that its origin might be lymphomatous and this deduction is borne out by examination with the finger and the posterior rhinoscope. Adenoids hold the chief place in causation and, as we should expect, both tubes are usually affected. Adenoids, fully considered in Chapter XV, produce obstruction in two ways. By exuberant growth close to the tubal orifice they press upon the Eustachian lips, which are hampered more and more, until deglutition, instead of habitually opening the aperture, does so only occasionally (remittent occlusion). In this case the result is due to simple, mechanical pressure and that alone. The other type of adenoid obstruction is due to lymphoid growths beneath the lining membrane of the carti-

laginous portion of the tube, gradually encroaching upon its lumen. Here, too, the phenomenon is one of pressure but there is also another feature. The protrusions from the tubal wall may cause increased rugosity of the surface and thus contribute to the hindrance of drainage. In addition, the effect produced is necessarily constant, not remittent, as was possible in the other case.

In the instances just considered, the mechanism of tubal obstruction is very plain, but in others it is less simple. We find occlusion when there is no obvious abnormality in the area close to the orifices and may erroneously conclude that we are dealing with the sequel of some antecedent inflammation. Such a condition should prompt us to investigate carefully the state of the structures further away from the tubal apertures. If we find tumors or marked hypertrophies, it is likely they are responsible for the obstruction, because they act as brakes upon the muscles whose action renders the apertures patulous, so that opening is much hindered or entirely prevented. Hypertrophy of the faucial tonsil is often responsible for obstruction, as is proved by restoration of tubal patency after tonsillectomy; and great enlargement of the posterior ends of the turbinals is another cause. Tumors, traumata and cicatrices are all occasionally etiologic factors, producing morbid alterations in the musculomembranous framework of the naso-pharynx and interfering with the position and interaction of its parts. Closely allied to these effects are those produced by ulceration, tubercular, syphilitic and sometimes diphtheritic and variolous. The clinical picture in all these cases is one of damage to the tissues, lessening their elasticity and motility and impairing their functions. In atrophic rhinitis, thick crusts often form near the posterior orifices of the nares and extend backward into the naso-pharynx. When so situated, they may close the tubal apertures causing atresia until they are dislodged. The congenital deformity of cleft palate is nearly always associated with tubal obstruction, partial or complete.

The pathological phenomena consequent upon interference

with the Eustachian functions can be recounted deductively for they are the reversals of physiological processes and the clinical history corroborates such a presentment. As has been observed, the tympanum resembles a serous cavity, hence in a normal condition there is some drainage of serum through the tubes. When they are occluded this serum accumulates first in the tubes themselves, under the influence of gravity, and then in the tympana where it slowly undergoes a physical and chemical change. At the same time the air in the chamber, incarcerated because there is no ventilation, gradually disappears, its oxygen probably uniting with the serum whose alteration is catabolic in character and its nitrogen being absorbed by the lining membrane. As the air lessens in quantity, the membrana tympani is pushed inward, presenting a concave surface at the lower end of the external meatus. Later on this retraction is followed by collapse and sometimes by atrophy.

These varied morbid changes are not inflammatory, but by reducing the vitality of the tissues and favoring the retention of retrograde products, they supply conditions favorable to the development of inflammation, and this often occurs as an intercurrent disease, when obstruction of the tubes is neglected and "left to nature." It is a morbid state replete with probabilities of untoward results, but also very amenable to therapeutic measures intelligently and skilfully pursued.

In this affection impairment of hearing is, in some degree, due to the occlusion *per se* but far more to the damage inflicted upon the tympanum, and a prime object is to prevent its further injury and to repair what has already been done. Treatment is therefore addressed both to the elimination of the causes and to the restoration of the structures which have suffered detriment. When the tubal orifice is closed by the direct pressure of contiguous adenoids, the growths must be extirpated (see operation in Chapter XV) and it will be found in many cases that their removal will bring about the disappearance of minor adventitious growths which yield to

the restored activity of the absorbents. When the trouble is due to hypertrophic extension of the turbinals into the naso-pharynx, the superfluous tissue must be removed by operation. The same advice applies to the faucial tonsils when they are the cause of occlusion. I have already (Chapter XIX) expressed my aversion to half-way measures in dealing with hypertrophied tonsils. Tonsillectomy, skilfully performed and followed by proper care during postoperative convalescence, is safe and efficient treatment and yields the best results. Tumors and cicatrices give rise to conditions of such varied character that treatment must, of necessity, be individualized. The extirpation of neoplasms and the cutting of adhesions which embarrass muscular action may restore the Eustachian orifice to a patulous condition; but in determining what measure to take, consideration must be given to all the results of operative interference upon the pharyngeal structures and functions. When rhinitis in any form plays a part in causing occlusion, that disease should be subjected to active and persistent treatment (Chapter VII).

Adenoid growths subjacent to the lining membrane of the tube are confined to the portion below the isthmus and their encroachment, while decreasing the lumen, very rarely goes far enough to produce occlusion. They are not susceptible to excision, but can usually be considerably reduced by medicinal applications so that their obstructive influence becomes slight. I am accustomed to begin treatment with an eight per cent. solution of tannic acid in glycerine carried to the constricted part of the tube by a cotton-tipped applicator which has been conformed to the shape of a Eustachian catheter. This should be used several times and if it prove inefficient should be replaced by a two to five per cent. solution of ethylmorphine hydrochlorate (dionin) in distilled water applied in the same way. Most cases will be benefited by this treatment. When the condition is obstinate, careful dilation with bougies may be practised, or absorption induced by electrolysis. In this procedure use is made of a thirty- to fifty-

volt battery and a current of from one to five milliamperes is passed through the thickened part of the tubal wall by means of an insulated bougie having an olive-shaped head of gold which rests against the constriction and is connected with the negative pole, while the positive electrode is held in the patient's hands.[1]

If tubal obstructions have been removed and, in consequence, drainage and ventilation reëstablished, there remains the therapeutic task of restoring the tympanum to its normal anatomical condition and of reviving functional powers paired during the period of occlusion.[2]

The retracted or collapsed drum-head can be reinvigorated by inflation of the tympanum with the Politzer air bag. The success attained greatly depends upon good judgment in carrying out this simple procedure with proper force and frequency. The purpose in view may also be promoted by treating the membrane upon its outer side with Siegle's otoscope and Delstanche's masseur (Chapter III, Armamenta) and an alterative influence can be exerted upon the debilitated membrane's nutrition by inunctions of mercury applied upon its exterior surface in the form of an ointment containing five grains of the yellow oxide in an ounce of petrolatum. These measures generally succeed in restoring the auditory conducting power to a large extent and sometimes, when the morbid changes have been speedily corrected, to a condition altogether normal.

[1] There is a striking contrast between the Eustachian tube and the other canal, with which comparison is naturally suggested by its similar liability to obstruction, viz.: the male urethra. Urethral strictures are common but their site is nearly always some point in the course of the passageway, scarcely ever at either the vesical or penial orifice; an exact reversal of what is observed in the Eustachian tube, in which occlusion is most common near one of the ends.

[2] In some cases, before the reopening of the tubes has been effected, the incarcerated serum, either on account of excessive quantity or degenerative change in its character, must be evacuated and myringotomy becomes necessary; but these instances are exceptional and description of the operation is deferred to the discussion of otitis media, in which it is often required.]

CHAPTER XXXI

SIMPLE OTITIS MEDIA: ACUTE AND CHRONIC

Nonsuppurative or Catarrhal Otitis Media

The morbid conditions of the middle ear so far considered have depended primarily upon tubal obstruction, however varied have been their secondary manifestations. We now pass to those whose common characteristic is inflammation, originating in different ways and developing in protean forms. Diseases of this kind are so numerous that if they were all eliminated there would remain little more than a third part of present otologic practice. The majority originate from pathogenic germs, conspicuous among which are the pneumococcus and the streptococcus pyogenes; the staphylococcus pyogenes also is frequently an etiologic factor, though most often associated with the late rather than the early stages of inflammation. A distinction between these affections and those of mechanical origin arises from the anatomical differences between the lining membrane of the tympanum and that of the Eustachian tube, where the obstructive lesions originate. The lower section of the canal is comparatively capacious and, as its orifice is near the junction of the breath-road and food-road, it is exposed to the action of the varied substances traversing each of these passages, whether they be organic or inorganic, the former including the micro-organisms of all kinds; hence the tubal mucosa acquires a tolerance of their presence and becomes fitted to neutralize their nosogenic influence, providing its normal mobility and proper circulation be not hampered by obstruction. On the contrary, the tympanum is normally an aseptic cavity defended on all sides from hostile intrusion, and its lining membrane exhibits the vulnerability characteristic of

serous tissues. If the fortifications are broken through, the invaders encounter little resistance in the cavity itself and its minute dimensions make difficult the task of therapeutic reinforcement. The result is that we can do comparatively little to antagonize tympanic inflammations by topical measures within the cavity, as contrasted with what we can accomplish by reconquering and holding the outer defenses and by modifying the vital processes of the whole organism in a way to diminish the virulency of the toxic attack.

On account of the peculiarly rapid histogenetic changes occurring in the aural region during the first two or three years of life, the acute diseases of infancy are very apt to affect the middle ear to a greater or less degree; the extent to which the tympanum is involved varying from a slight congestion to a suppurative otitis. The mild cases greatly preponderate in number and, barring some special complication, spontaneous recovery accompanies convalescence from the systemic malady and no permanent sequels remain, the rapid metamorphosis of tissue promoting a return to normal conditions as, under the influence of a general morbidity, it had assisted in extending the disease.

Under the title Simple Otitis Media: Acute and Chronic, I include those cases of congestion and inflammation of the middle ear, howsoever produced, which are not accompanied by suppuration. The classification is symptomatic rather than etiologic, but is adopted on account of its great convenience. Subsequent to the period of infancy, this form of otitis has two causes, which give rise to the great majority of cases, and both causes nearly always act in a secondary or intermediate way. The first is coryza,[1] or "catching cold," the second the group of infectious fevers. In that morbid process called coryza, so exceedingly common in our variable climate, the ear is often affected, but always secondarily; at least, I have never seen it

[1] Coryza is specified separately from the infectious diseases, because of uncertainty regarding its etiology, a matter which is fully considered in Chapter VII.

the subject of a primary attack. The naso-pharynx shows inflammatory manifestations which the practiced eye will recognize as antecedent to any presented by the tube and tympanum. Moreover, the rational symptoms point to the throat and nose as being first affected. In the infectious fevers, the same statements hold good. A posterior rhinoscopic examination will prove that the naso-pharynx is involved, often to a marked degree, at the inauguration of the tympanic trouble. There can be no doubt that in a great majority of instances the ear is affected, not through the sanguineous or lymphatic circulation, but simply and wholly by an extension of the morbid process into the Eustachian tube and through it into the tympanum, such extension being facilitated by the continuity of the lining membrane from the aperture of the tube to the interior of the tympanum.

While simple otitis media usually originates in these ways, there are certain other causes to be mentioned. Tubal occlusion (Chapter XXX) if long continued, or recurring very frequently, may set up inflammation and the same result may follow traumatism of the drum-head. There are also two artificial excitants for which pharyngology is responsible. The use of the galvanocautery in the nose and throat has produced otitis in a number of instances, as has also the tight tamponing of the naso-pharynx, when the packing was retained for a considerable time. It is possible that these untoward results give no just grounds for criticism of the operator; for the conditions demanding the cautery and the tampon may have been of such an urgent nature that he would have been justified in using them even if certain that otitis would follow. Often a dilemma compels a surgeon to choose the lesser of two evils and this is a truth which must ever be remembered in judging the work of our colleagues but, nevertheless, it is essential to know that the galvanocautery requires great caution in its use and can never be classed among the things which are safe for routine employment. The tampon also has its dangers, though it appears so harmless both in the material of which it consists and

in the method of its application. When inserted firmly, it greatly constricts the blood vessels, producing venous stasis in the area of direct pressure and passive congestion in near-by tissues; so the time of its retention should be as brief as will accomplish the purpose for which it was used and it should not be introduced by one man, with the view to its removal by another who succeeds him on duty, a dangerous practice sometimes seen in dispensaries. It is a useful appliance, but never wholly devoid of danger till removed.

Cold bathing has long been counted among the habits injurious to the hearing. The older writers attributed the harm done to the shock caused by sudden lowering of temperature and this doubtless affects some persons, though many escape. The influence of thermic changes, like that of others, is modified by individual characteristics. There is another way in which those addicted to cold bathing may suffer aural injury, a way seldom, if ever, mentioned in books. Many persons prefer a plunge into a lake, stream, or even pond, as more pleasurable than immersion in a bath tub, unmindful of the fact that the water in streams and especially ponds is often contaminated in many ways, and the active muscular movements of outdoor bathers bring much water into the naso-pharynx, whence it may enter the tympanum through the Eustachian tube and deposit its impurities where they have every opportunity to do harm. Pure sea water with its saline content is usually a beneficial wash for the mucous membrane, but the water upon the beaches of the large seashore cities is not always pure. It often has an admixture of sewage and always carries during bathing hours the varied dermal excretions of the throngs, healthy and diseased, disporting in the surf. The proportion of injurious, organic matter in such water is small; but a few particles of toxic character are quite sufficient to affect a susceptible membrane like that which lines the middle ear. The thousands who make merry in the surf are in very active motion, many of them shouting and laughing. They imbibe a great deal of water and, in

swallowing, open the lower apertures of the tubes so that it is very easy for some of the water to find its way into the tympana and, if it carries the washed off detritus of tubercular or syphilitic sores, or some virulent cells from a dripping gonorrhœa, the bather may have serious cause to regret his sport in the "joyous, health-giving breakers of old ocean."

There is another practice which has caused more middle-ear disease than the various forms of outdoor bathing. I refer to the gravity nasal douche which sends a stream of water into one nostril to escape by way of the other. Half a century ago this little instrument came into general use by the recommendation of physicians who regarded it as a safe and efficient cleanser of the nasal passages. The douche was simply a glass vessel shaped somewhat like a slipper with a small orifice at the narrow end (the toe) and a larger one at the top, the latter used for filling the chamber and the former for insertion into the nostril. It was easily manufactured at a trifling cost and yielded to the seller even when marketed at a small price, a profit of several hundred per cent. It became popular with the laity and in a few years the sales reached a nearly incredible figure. After a time it was observed that many persons habitually using the douche contracted disease of the middle ear and comparisons of experiences by otologists put beyond question the fact that the douche was an etiologic factor in otitis media. Professional opinion soon came to discourage its use, but wholly upon empirical grounds; for why it did harm was not then understood. The development of bacteriology shed a clear light upon the nosogenic process and it became plain that infectious germs borne by the water into the naso-pharynx found entrance to the Eustachian tube and thence to the tympanum. The use of the douche by the laity is now wholly discountenanced among physicians and its employment even in tainted hands is restricted to a few conditions and in these cases care is taken that the tubes shall be fully safeguarded. The amount of otitis due to the douche has greatly diminished in recent years but there are still

attacks referable to this cause, the patients having generally used the instrument as inexpensive home treatment, upon the advice of friends and neighbors.

The symptoms of otitis in its first stage are often masked by those referable to some acute general disease which is coexistent. Pain is the most frequent subjective sign and its presence in the aural region has much diagnostic significance, for there is little explanation for it, aside from disease of the ear. The first morbid sensation is commonly a sense of fulness, "stuffiness," in the throat and ear upon one side, accompanied by some stiffness of the muscles. These phenomena are coincident with the onset of congestion in the naso-pharynx and Eustachian tube and are soon followed by acute pain in the tympanic region, often seeming to radiate from the external auditory meatus and commonly growing worse in the evening. The severity of this pain depends upon the gravity of the disease, but even more upon the neural susceptibility of the patient and ranges from intermittent twinges to constant suffering so great as to call for the hypodermic injection of a sixth or fourth of a grain of morphine. The clinical thermometer registers some increase in the temperature of the body but this, unless influenced by a coexisting constitutional malady, seldom exceeds 2° or 3° F. An exception must be noted in regard to children, in whom the elevation may rapidly reach 104° or 105° F. Their great susceptibility in this respect explains the fact and on this account marked thermic changes have in children far less significance than in adults.

Upon inspection with the aural speculum, the membrana tympani is found much reddened and lacking its normal pearly luster. It may be either pushed in or bulging, the former condition indicating a rarefaction of the intratympanic air and the latter an accumulation of serum. There is usually a quite noticeable impairment of hearing in the affected ear, particularly affecting tones of low pitch and readily tested by tuning forks standardized for from 100 to 256 V.D. This

surdity is annoying to the patient but frequently he has a much more distressing symptom in the onset of tinnitus aurium. This subjective sensation, due to hyperæsthesia within the tympanum and to alterations in the normal posture of the ossicles, simulates a great variety of objective sounds and these are iterated and reiterated until the annoyance at first produced becomes exasperation. They "get on the patient's nerves," in both a literal and metaphorical sense and some neurotic sufferers have been made so desperate that they have sought the advice of charlatans who promised them relief, and have in consequence incurred permanent injury as the result of operations upon the drum-head and ossicles, to put an end to the tinnitus. If the physician can gain the full confidence of such patients, he can render them a very great service by assuring them that this symptom is nearly always dependent on conditions which are curable and that resolute endurance for a brief time will almost certainly be rewarded by its disappearance. He should, of course, meanwhile employ such palliative measures as can be used without damaging the tympanic structures. In favorable, uncomplicated cases the acute attack terminates by resolution in a few days and rarely continues more than one or two weeks. These satisfactory results are sometimes spontaneous recoveries in patients who have had no treatment whatever, but such good fortune is by no means the rule. When left to nature, the disease tends to progress to suppuration, or to assume a chronic form characterized by sub-acute, nonsuppurative inflammation. This is a cogent reason for prompt and energetic therapeutic action and it is reinforced by the fact that such action proves, in a great majority of cases, fully curative.

The treatment now approved by the consensus of professional opinion is based upon the etiology of the disease. We have seen that, with few exceptions, the complaint is secondary to affections of the naso-pharynx and it is to these affections that our remedial efforts must be addressed. All morbid conditions in this cavity and the contiguous region must be fully investigated

and their correction persistently sought in our scheme of therapeutic procedure. Surgical operations, however, are to be postponed until acute inflammation has subsided. A thorough cleansing of the nasal and pharyngeal cavities is not only beneficial *per se*, but important as a preliminary to other measures. Dobell's solution should be sprayed through the nostrils to dislodge the coating of thick, tenacious mucus which is commonly found in the posterior nares and naso-pharynx. If this prove insufficient, a pledget of cotton wound upon a flexible applicator should be saturated with the liquid and carried along the floor of the nose through the posterior orifice and there used as a mop to free the naso-pharynx from the layer of viscid secretions. If the tip of the applicator is bent to the shape seen in a Eustachian catheter, it will be efficient for dislodging the semi-solid plug often found occluding the aperture of the tube.

In this, as in other acute inflammations, constitutional treatment is valuable, though it seldom does the good of which it is capable because patients are unwilling to interrupt their usual occupations on account of an illness which they consider of minor importance. There is great advantage in complete cessation of mental and physical work with rest in bed as long as there remains any elevation of temperature. Moderate purgation is to be secured with saline laxatives and, till convalescence, a milk diet should be directed with the withdrawal of alcoholic stimulants, tea, coffee and tobacco. When the pyrexia is marked, very good results follow the administration of tincture of aconite in small and frequent doses. Its relief of vascular tension is speedily followed by a fall in temperature and an amelioration of the pain quite as great as can be secured by remedies of the analgesic class.

While our main reliance is upon such measures as have been enumerated, topical treatment has real value, chiefly in palliating symptoms and warding off structural changes, until the attack has completed its clinical cycle. The rarefaction of the air within the tympanum, so frequently observed, logically sug-

gests inflation of the cavity, as an obvious method of correction, and the advantage of this procedure has been fully established by experience. The Politzer air bag, either alone or in conjunction with the Eustachian catheter, is employed for this purpose (Chapter III). The impulse given to the column of air is at first very gentle, a slight, progressive increase of force being allowable at subsequent inflations, as the favorable effects of the treatment become manifest. These effects are watched by means of both the auscultation tube and the aural speculum. When the inflation accomplishes its purpose, we observe that the drum-head is no longer pushed in; the congestive redness is gradually replaced by the normal pearly luster, and the triangle of luminosity little by little recovers its brightness. At the same time there is improvement in the hearing and the tinnitus becomes less distressing and subject to periods of remission.

Local applications of a palliative kind include the ice-bag or the hot-water bag over the mastoid region. One or the other usually affords the patient considerable relief; but whether heat or cold will do good depends almost entirely upon certain individual traits. In the old systems of medicine these traits were recognized and classified as temperaments. The word with its qualifying adjectives has long disappeared from scientific treatises but is still retained in the common language; men still speak of the sanguine temperament, the lymphatic temperament and three or four others. These popular terms, however unscientific they appear, convey a real meaning. In the matter under consideration, if the patient be of what is called the sanguine temperament, he will be benefited by cold, not by heat; if his temperament be lymphatic, heat will do good, while cold may aggravate his suffering. The use of morphine and of aconite in the control of pain has been already referred to. There is also a topical remedy whose value is attested by much experience in cases where the afferent nerves of the membrana tympani seem to be those chiefly affected. This is a ten per cent. solution of carbolic acid in glycerine. A few drops are instilled into the external auditory meatus, which has previously

been cleansed of cerumen and other substances so as to give the best opportunity for absorption. The application of leeches, either living or mechanical, over the mastoid process of the temporal bone, I have not found necessary and I do not approve the practice. My judgment is also averse to the use of the tincture or other preparations of iodine in the same locality.

Simple otitis media in its chronic form, called also chronic catarrhal, and chronic nonsuppurative otitis media may be the continuation of an acute attack which has been intractable or, more often, which has failed to receive proper treatment. It may also from the beginning manifest the characteristics of a sub-acute, sluggish inflammation—an extension of a similar process affecting the nose or pharynx. The tinnitus and other symptoms are much like those already described, subject to modifications by the diminished activity and acquired tolerance which accompany chronicity. The partial deafness often exhibits a very peculiar quality. The patient when engaged in conversation with one person displays decided impairment of auditory power; but in the mingled noises of a crowd, where many persons are talking simultaneously, he hears better and is nearly on a par with a normal individual who is much embarrassed by the confusion of sounds. So too amid the clatter of a mill or of a railroad train, this patient has relatively an advantage over a man with uninjured ears. This curious physiological paradox has been termed *paracusis Willisiana*. Such a patient, while striving to apprehend a dialogue whose words are uttered with more than ordinary force and distinctness, is liable to be startled by some shrill, high-pitched tone, suddenly impressing his audition with exaggerated force, a phenomenon called *hyperæsthesia acoustica*. This experience may be surprising because of its disturbing intensity; but it is in accordance with the well-recognized fact that surdity dependent on damage to the conducting mechanism often causes little impairment of function for tones of high pitch which may even in some instances acquire abnormal distinctness. Coincident with the aural manifestations, attacks of vertigo occur in a con-

siderable proportion of cases, apparently due to disturbance of the endolymph and perilymph of the semicircular canals.

The physical signs include those alterations in the drum-head, which have been mentioned in describing affects of the acute attack, with the addition of others due to the prolongation of the morbid process. The membrane is pushed in and has a congested, opaque and lusterless appearance. In time nutritive changes occur; they may be either hypertrophic or atrophic. In the one case there is more or less thickening and stiffening of the tissue; in the other, which is less common, the membrane becomes very thin, translucent and brittle, so that it is liable to fracture from very slight causes. A thin and semi-translucent membrane is shown in Fig. 110.

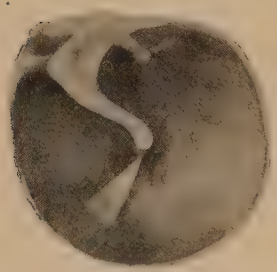


FIG. 110.—Simple otitis media; chronic form. The drum-head is pushed in and very thin; the luminous triangle has receded from the periphery and the incudo-stapedial junction is visible on account of the partial translucency of the membrane.

The affection of the middle ear may be accompanied by disease of the labyrinth, and the question of the presence or absence of such a complication should be determined as definitely as possible soon after the case has been undertaken; but certain measures of treatment necessary in either event may be inaugurated without waiting for a thoroughgoing test of the internal ear, for it is important on psychic as well as therapeutic grounds that something should be done for the patient at once. The qualitative examination upon which the diagnosis will depend should include the Weber, Rinnè and Gardner-Brown tests (Chapter XXVIII). By repeating each test and then collating and comparing all the results, the liability to error will be reduced to a minimum and a conclusion reached, which will be a safe guide in treatment.

Chronic median otitis shows very little tendency to spontaneous recovery; its duration depends almost wholly upon the

therapeutic measures adopted. Its prognosis is far less favorable than that of the acute type, but nevertheless it is often curable if the patient be able and willing to undergo a thorough course of treatment. This treatment comprises features growing out of the etiologic conditions, others that are constitutional and finally measures of a topical kind. As in the acute form, so here, every effort must be made to restore the health of the nose and throat and thus eliminate the causal factors of the otitis. If this restoration cannot be fully accomplished, we may not hope for entire success with the ear, but must endeavor to confer upon our patient as much benefit as possible by such partial improvement as may be attainable.

In this, like other chronic diseases, constitutional treatment assumes great importance. Local inflammations are usually self-limiting and when they fail to disappear the chronicity itself raises the suspicion that there is some systemic morbidity which nullifies the reparative efforts of the organism. Of the real nature of such morbidity we know little; it is referred to as a diathesis and is thought to depend on disordered metabolism, hence if we can remove from the blood and the tissues deleterious substances, which the excretory organs have failed to eliminate and can supply in their place healthful nutriment, we may restore the vital functions to normal conditions and enable them to repair the damage wrought by disease. As our purpose is to promote changes in the blood and the tissues, it is obvious that what retards the process of elimination and renewal must be avoided, hence coffee, tea, cocoa and alcohol are to be withdrawn from use while treatment of this kind is being employed. These theoretical considerations have the support of experience. It has been proved empirically that local inflammations which were intractable under topical treatment alone have speedily yielded when the local measures were reinforced by constitutional therapeutics, at first detergent and then tonic and roborant.

In chronic affections of the middle ear the indications point, first, to laxatives, diuretics and warm baths, to promote

the elimination of useless and injurious organic substances—all the remedies to be used with discretion, avoiding excess and adapting them to the individual requirements of each patient. The second stage of the treatment comprises a nutritious, unstimulating diet, moderate, regular, muscular exercise and, in some cases, the preparations of iron. The general tonic effect following a change of scenes and associations frequently proves very beneficial.

If success attends the efforts directed to improvement of the general health, the results of local treatment will often be surprisingly good, both as to the restoration of the tissues to their normal state and as to the resumption of functional activity. For producing a direct effect upon the middle ear the procedures which I regard as most beneficial are inflation (Fig. 111), aural massage and dilation of the Eustachian tube.

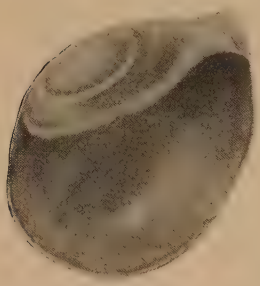


FIG. 111.—Simple otitis media; chronic form. Appearance of the drum-head after inflation.

The introduction of air by the Politzer bag and the Eustachian catheter already described, may be rendered more efficient in chronic otitis by impregnating the air with medicinal vapors and sprays. Five or six drops of ethyl iodide or a like quantity of chloroform may be added to the atmospheric content of a Politzer bag before an inflation and thus reach all parts of the interior in vaporized form. A two to five per cent. aqueous solution of ethylmorphine hydrochlorate (dionin) introduced by a pipette into the catheter is distributed in a similar way by the air blast from the Politzer bag. An oleaginous remedy is applied in nebulized form by putting into an atomizer a solution of camphor and menthol (two per cent. aa) in liquid petrolatum, throwing its spray into the catheter and then distributing it with the air blast. All these remedies are of approved value, the one best suited to each case de-

pending upon pathological details: sometimes they prove very efficient when used interchangeably.

Massage of the membrana tympani by the successive condensation and rarefaction of the air upon its outer surface is effected with the Siegle otoscope and Delstanche masseur (Chapter III), their careful use often proving very beneficial. Another instrument applied to the exterior of the drum-head is the Lucæ probe. This has a cup-shaped end which is placed directly over the short process of the malleus, or the stapedio-incudal junction, and is then alternately compressed and retracted in a gentle manner with the purpose of imparting vibration to the malleus and other ossicles, which have become more or less agglutinated by inflammatory products.

The dilation of the Eustachian tube by bougies or by electrolysis, mentioned in connection with obstruction (Chapter XXX), is at times required in chronic otitis, though the tube is often greatly improved as a result of etiologic and constitutional treatment such as has been detailed.

CHAPTER XXXII

PURULENT OTITIS MEDIA: ACUTE AND CHRONIC

This type of otitis is characterized by the presence of pus which either perforates the membrane or the osseous walls of the tympanum spontaneously, or is found within its cavity when there is incision of the drum-head. Its etiology is virtually the same as that of the simple form, with the addition of the circumstances and incidents, which intensify or prolong the inflammation to such an extent that it becomes suppurative, and among these the commonest aggravation is that caused by the neglect of treatment. The affection is generally unilateral and its symptoms have the same order of development as is observed in unilateral, simple otitis, but they are said to be more severe through all the stages and even at the onset. I think this often reiterated statement is a less accurate expression of the facts than is given by saying that otitis of mild type may run its course and terminate by resolution, even without treatment, such a case being classified as simple and acute, while otitis of severe type will, unless modified by treatment, advance to suppuration and be called purulent. In other words, the disease is not severe because it is purulent, but purulent because it is severe. Fig. 112 shows the drum-head distended with pus.

FIG. 112.—Purulent otitis media. The distended part of the drum-head was filled with pus, which was evacuated by incision.

This affection is very common in infancy and childhood

where the rapidity of tissue change leads to inflammatory processes from causes which do not produce them in the adult. It accompanies the infectious fevers so often that its presence, at some stage in their course, may be anticipated and the frequency of this connection is proved by the statistical observation that pus is found in the middle ear at all postmortem examinations following scarlet fever, measles and smallpox, and in a large proportion of those following diphtheria. This and other facts lead to the conclusion that it is a rare thing to find an individual, who has not at some time in his life had pus in the tympanic cavity. This part of the organism is evidently very susceptible to the morbid influences which cause suppuration, a fact which influences both our prognosis and our treatment, but side by side with this fact is another of equal significance; this portion of the ear is endowed with great recuperative power; its liability to disease has an offset in its capability of recovering from the effects of morbid influences. This is incontestibly shown by the aural state of recruits for our army and navy and by the occupational examinations now so much in vogue. In a large majority of the adults subjected to tests conditions are normal, or nearly so, in spite of the vicissitudes through which they have passed in earlier years. It thus appears that the middle ear is a peculiarly important field from the professional point of view; a field capable of much fuller cultivation than it has yet received, for it needs an unusual amount of therapeutic care and it will respond favorably to such care in a degree equally unusual.

The microbes found in the discharges, whether they are etiologic or only coincident, are not restricted to a particular species. Streptococci are commonly present when the otorrhœa is associated with measles or scarlet fever, the pneumococcus and bacillus tuberculosis have been observed in diphtheritic cases and in some of rhinologic origin, while nearly all constitutional diseases intercurrent with the otitis are at times represented in the secretions by their own characteristic germs. The bacteriological findings do not, at present, throw much light upon treat-

ment, except to emphasize the importance of careful and continuous asepsis.

Impairment of hearing is a constant symptom, but there is much variation in its degree and also in its persistence. It may continue for weeks or even months and then disappear leaving the function in a normal, or nearly normal condition. The defect is in the tones of low pitch and unless there is coëxistent disease of the internal ear, the tones of high pitch are but little affected. The other factors of the symptom-complex already given are modified chiefly by the phenomena of intercurrent constitutional maladies, or by the mechanical effects of purulent accumulations. Scarlet fever, which manifests a marked tendency to injure the ear and all contiguous organs, may cause facial paralysis, or may start suppuration in the lymphatic glands of the neck developing *pari passu* with the purulent otitis media. Imprisoned pus will cause the drum-head to bulge into the external auditory meatus and will give to the tinnitus present a peculiar pulsating quality, the noise assuming rhythmical characteristics in unison with the beating of the heart. This development is accompanied by throbbing pain, radiating from the tympanum and sometimes associated with tenderness over the mastoid, even prior to the involvement of the mastoid cells.

Between acute, purulent otitis media and the chronic type of the disease no hard and fast line can be drawn. One form merges into the other by gradations which sometimes put the emphasis upon one development, sometimes upon another. Aside from the fact of chronicity itself, the most characteristic differential sign of the long-established process is the outflow of pus through an aperture in the membrana tympani. The formation of such an aperture appears to be a mechanical necessity, in view of the accumulation of pus within the tympanic cavity; if such accumulation extends beyond a very brief period, hence the "running ear" is associated with a continuing otitis. Undoubtedly, this association is nearly always justified by the facts, but even here we may find an anomaly. It is possible that a small quantity of pus might exude from a pyogenic area of very limited

extent and be carried away by the Eustachian tube, so that the suppuration might continue some time without producing distention of the membrane or giving any other notable sign of its existence.[1] In such a case there would be chronic purulent otitis media without perforation of the drum-head. Such a rare phenomenon is suggested as a possibility of morbid action in this region, where we must always be prepared to encounter the exceptional. It is now universally recognized that the aural affection is usually dependent upon nasal morbidity and that when the nose is cured, spontaneous recovery may occur in the ear, hence a thorough rhinological examination should always be made and if abnormal conditions are found, every effort should be made to correct them before applying active treatment to the ear, provided the aural and constitutional condition allows an interval of delay during which local treatment of the ear is restricted to palliative measures.

In acute cases, the first step in topical treatment is often myringotomy. This is indicated when the tympanum is filled by a liquid which, on account of obstruction in the Eustachian tube, has no avenue of escape. Through the speculum the membrana tympani appears congested and bulging outward, while the coincident symptoms are fever, tinnitus, partial surdity and throbbing pain. When these conditions are present, the external auditory meatus is to be cleansed with a solution of sodium bicarbonate, two drams to a pint of water, and then wiped out with a solution of carbolic acid, ten per cent. in glycerine, applied by a cotton-tipped probe. This deadens the pain in some degree and, as the operation is very quickly done, I am in the habit of performing it without any other anæsthetic, but if the patient is nervous and very apprehensive, he should inhale enough ethyl chloride to induce a very brief anæsthesia. The opera-

[1] In a case like that postulated, if the concealed pus should ultimately enter the antrum and set up mastoiditis, the process would explain disease of the cells, which otherwise would be considered a primary affection, something whose occurrence is not free from doubt.

tion is done with the myringotome, a slender bistoury, and the incision made with it through the membrane is crescentic in shape; it begins at a point just below the incudo-stapedial articulation and extends along the posterior side of the membrane downward and forward for a distance of about six millimeters. Through this opening the incarcerated fluid escapes into the meatus, whence it is carefully removed and a wick of gauze inserted for drainage; after this the ear is covered with a sterile dressing. Inflation with the Politzer air bag should be practised daily after the operation and, if the discharge is profuse, a hot solution of boric acid, ℥j to Oj, should be used for irrigation. Generally there is rapid decline in the fever and pain after the pus is liberated, but in some persons there are exacerbations of pain at intervals. In these cases a hot-water bag applied over the auricle affords relief. The tendency of wounds of the membrana tympani to heal very rapidly may bring about a closure of the outlet while suppuration still continues. In this case the myringotomy must be repeated and an orifice kept open until the otorrhœa ceases through the cure of the inflammation, when the aperture is allowed to close. Afterward the inflations are to be continued upon alternate days, until tinnitus disappears and the hearing regains its normal acuteness.

Long-continued inflammation very often stimulates cellular production, but the creative energy is misdirected and the resultant growths are of morbid character and tend to displace and destroy the normal tissues which surround them. The histologic elements of such growths are sometimes unnatural and foreign to the human body, but much oftener they are cells which would be normal in their proper environment, but become injurious by growing in improper places.[1] Chronic purulent

[1] The ancient physicians who were fond of expressing ideas in proverbial form, especially in rhymes which helped to fix them in the memory, incorporated this thought in Latin verse:

"Res natura bonæ,
Quum male positæ,
Sint sæpe pessimæ."

otitis media is frequently complicated by cholesteatomata, which are misplaced and degenerated accumulations of cellular elements naturally belonging to the epidermis. The pathogenesis of these masses usually begins by an extension of the skin from the external meatus into the tympanic cavity, where the epithelium gradually loses the qualities characteristic of a seromucoid membrane and takes on those of the cuticle. Under the hyperplastic stimulation of the chronic otitis, there is rapid proliferation and desquamation of epithelial cells, which are carried away in the purulent discharge and may readily be detected by a lens of moderate magnifying power. The presence of such cells is of much diagnostic value provided the precaution has been taken to thoroughly cleanse the external auditory canal before taking a specimen for examination. Otherwise, the middle-ear discharge may be contaminated by substances originating in the meatus, prompting a wrong judgment. So long as the proliferation of these cells is balanced by their discharge with the suppurative outflow, they give rise to no special symptoms, but when such a balance is disturbed, as it is likely to be, their accumulation soon alters the intratympanic condition. A slight obstruction causes the retention of a few cells; these form the basis for an aggregation which, as it increases, steadily adds to the obstruction so that the cellular mass grows at a rate which constantly tends to acceleration. This enlargement inaugurates the second stage which continues until the available space is all occupied, except a passageway of variable size through which there is still drainage of pus, though often in lessened quantity. The cholesteatoma now shows the effects of the pressure exerted by surrounding structures and it invades any cavity where it has a chance for expansion. In this way the attic is occupied to its fullest capacity and the growing mass pushes on through the adjoining aditus into the antrum unless, prior to this invasion, its expansion has been arrested. While this process goes on under continuous pressure, the mass becomes much denser and passes through changes which simulate those of neoplasms, though it does not reach a

true organization of structure. The epithelial elements, greatly compressed, tend to an arrangement in concentric layers, enveloping a core of caseous matter made up of inspissated pus and of cells undergoing fatty degeneration, and the external surface may be covered by a smooth, thin capsule. The continued growth of this morbid mass, coupled with the lack of room for its accommodation, ushers in the destructive stage, during which the contiguous soft parts are removed by atrophy or by ulceration and the compressed bony walls, deprived of their blood supply, undergo gradual absorption. As a result, the cholesteatoma may penetrate the tegmen tympanicum and cause intracranial infection, or a fatal hæmorrhage may be caused by erosion of the walls of the lateral sinus or of the internal carotid artery.

The symptoms, which are more or less intermittent, are pain due to pressure and a sense of weight and fulness in the tympanum together with a variable degree of surdity. The morbid mass is itself insensitive, as it is devoid of nerves. The impairment of hearing bears little relation to the gravity of the disease and may continue slight up to the onset of fatal invasion of the brain. The extent to which audition is affected depends less upon the size of the morbid growth than upon the integrity and mobility of the ossicular chain and normality of the inner wall of the tympanum, through which in many cases vibrations continue to be transmitted, although the atrium is nearly filled by degenerating cells. The diagnosis rests upon careful observation of the morbid process and on finding cutaneous epithelium in the purulent discharge. When it is habitually present, there can be little doubt of the presence of a cholesteatoma, and when it is suspected, search for it should be patient and thorough.

Treatment has as its object the eradication of the growth and the prevention of recurrence. When the mass is of moderate size, within view through the speculum, and not incapsulated, it is often practicable to break it up and wash it away with a warm solution of mercury bichloride, one part in three

thousand (1:3000). The ordinary aural syringe proves efficient for this purpose, when the mass is in the atrium, but if it fills the attic, as it frequently does, it may be necessary to employ a specially adapted instrument, such as that of Hewitt (Fig. 113). When unusual density and hardness prevents disintegration, softening can usually be effected by instilling the stock solution of hydrogen peroxide, drop by drop, until the frothy appearance of the surface of the impaction shows that the chemical reaction is taking place, when the syringing can be

FIG. 113.—Hewitt's apparatus for dislodging cholesteatomata from the middle ear.

resumed with better prospect of success. In exceptional cases, it may be necessary to employ a small ring- or spoon-shaped curette to break up a mass that is peculiarly hard and dry, so that its fragments may come away with the water jet. This will be facilitated by applying with a pipette a few drops of the usual (1:1000) solution of epinephrin chloride which by blanching and contracting the lining membrane of the tympanum will retract it from contact with the morbid mass, thus rendering the latter movable.

When cholesteatomata can be dislodged in the way described and their fragments removed through the external auditory meatus, this is the method of preference, but sometimes they

are too large, cases having been reported where the incapsulated mass reached the size of a pigeon's egg. In such instances they have, by effecting destruction of the osseous partitions, converted the tympanum, antrum and mastoid cells into a single cavity, not only rendering an operation from the outside necessary, but in a sense paving the way for its performance.

Polypi constitute another complication of chronic purulent otitis media (Fig. 115). The structure of these growths has already been discussed in Chapter V and here it is only necessary to add that when occurring in the middle ear they are the result of the exuberant granulations induced by chronic purulent inflammation. When they have a distinct pedicle, as they commonly do, the best method of treatment is extirpation with the cold wire snare (Fig. 114). The pain caused by

FIG. 114.—Blake's cold wire snare for removal of growths from the external auditory meatus and the tympanum.

this operation is slight, but it is well to paint the polyp with a four per cent. solution of cocaine and one of epinephrin chloride (1:1000) as the former will prevent any suffering and the latter will forestall any probability of hæmorrhage. After the application of these solutions, the snare loop of fine, brass wire is adjusted over the bulb of the growth and brought as close as possible to the base of the pedicle. It is then slowly withdrawn into the shaft of the instrument and the polyp strangulated and excised. When the pedicle is very short, or the growth is sessile, cutting forceps (Fig. 116) may with advantage be substituted for the wire snare. The raw surface left by either instrument is to be dusted with boric-acid powder which is often the only subsequent treatment required. If the healing process is tardy, the denuded spot should be touched with a bead of fused chromic acid, any superfluous action of the caustic being checked by powdered sodium bicarbonate.

FIG. 115.—Polypus protruding through perforation in Shrapnell's membrane and chalk deposits in drumhead caused by chronic, purulent otitis media.

(*Facing page* 372.)

To prevent the recurrence of cholesteomata and polypoid growths, we must secure efficient cleansing of the region affected by the otorrhœa and, as far as may be possible, render it aseptic, while treatment is continued for the cure of the otitis. Signs that the growths are returning indicate the use of fused chromic acid at the point where the marks of recurrence appear, and this will generally prove an efficient check without causing any severe reaction.

The therapeutic measures detailed above may be expected to effect a cure in uncomplicated cases and also in many attended by complications, provided the diseased action is re-

FIG. 116.—Hartmann's cutting forceps. They are adapted for removing polypoid growths, which are sessile, or have very short pedicles.

stricted to the membranes lining the tympanum, or to outgrowths and proliferations of those membranes. We may hope to restore the membranes to a normal state and thus put an end to the otorrhœa and the other consequences of their morbidity, but if the ossicles have become necrotic, the damage is probably irreparable and their carious condition will keep up the obstruction and suppuration as long as they remain in place. Under such a condition it may be best to resort to ossiculectomy, the sacrifice of the bones proving but a small loss, because on account of necrosis they have already lost their functional value as a part of the conducting mechanism of the ear.

In ossiculectomy the instrumental work must all be done

through the space encircled by the tympanic ring, hence the membrane must be freely incised to give room for the operation. When there already exists a large perforation, the best plan is to extend its area as much as necessary by cutting toward the surrounding ring, the exact method being determined by the locality and the size of the existing orifice. When this is too small to be available, a satisfactory opening can be made by a crescentic incision beginning at the posterior fold of the drumhead and extending downward and forward to the anterior fold. By this aperture the tympanic cavity is exposed to view and room given for the subsequent procedures. This paracentesis and the following operation may be performed under general anæsthesia, but the local method is usually preferable. For this purpose use is made of a hypodermic syringe with a long needle, and into its barrel is put the following solution, all of which is to be slowly injected.

℞. Cocaine hydrochlorate..... gr. ¾
Epinephrin chloride, solution (1: 1000).....♏ 2
Normal salt solution.....q.s. ad. ♏ 15 M.

The needle makes a puncture in the cutaneous lining of the upper wall of the external auditory meatus at the junction of the cartilaginous and osseous portions, and the injection is made at this point (Fig. 117). Immediately afterward a plug of gauze or cotton, saturated with a solution of the same strength, is applied to the surface of the membrana tympani and hastens the anæsthetic effect by reinforcing the injection. The desensitization produced extends over the whole field of the projected operation and becomes complete in from eight to ten minutes.

On account of the shape and structure of the ossicles and the contracted space in which the operation must be performed, ossiculectomy requires an assortment of specially adapted instruments and those which I consider best suited to the purpose are shown in Fig. 118.

Naturally the malleus is the first ossicle to be ablated. An angle-bladed knife (Fig. 118D) is employed to cut the tendon

of the tensor tympani muscle which is divided between its attachment to the malleus and the internal (labyrinthine) wall of the tympanum. To make sure that the tendon has been severed, it is well to pass the point of a bent, slender probe beyond the malleus and to move it along the surface of the ossicle where, if the tendon has not been divided, it will be encountered by the instrument. The angle blade of the knife is introduced again to free the malleus from connective-tissue adhesions and to separate it from the incus at the point of articulation. The

FIG. 117.—Position of needle to inject anæsthetic into wall of external auditory meatus.

ossicle is then grasped with forceps (Fig. 118C) and a movement of partial rotation, to and fro, used to dislodge it. When found to be free, it is thrust backward and downward from the attic into the subjacent space and then withdrawn through the incised membrane and the external meatus.

Ablation of the incus is affected by severing it from the stapes at the incudo-stapedial articulation with the angle-bladed knife, and then dislodging it with the incus hook (Fig. 118F), a manœuver at times rendered less easy by the loss of a part of the ossicle by necrosis—an occasional result of prolonged suppura-

tion. The dislodged incus is extracted by the same route as the malleus and, in all the measures detailed, particular caution

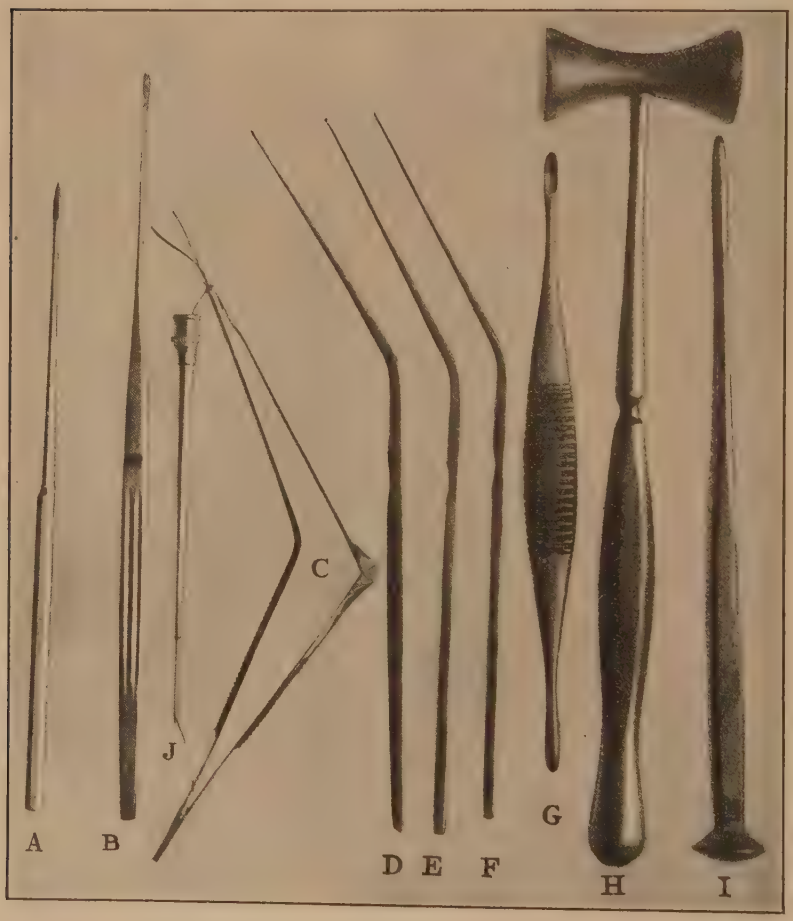


FIG. 118.—Instruments used in operating on the ossicles. *A*, Denche's straight tympanum perforator; *B*, *D*, *E*, Sexton's ossicle knives; *F*, incus hook; *C*, Sexton's ear forceps; *G*, Randall's mastoid curette, double ended; *H*, mastoid mallet, lead filled head; *I*, Alexander's mastoid chisel.

is observed not to injure the stapes nor to loosen its foot plate from its normal implantation at the oval window, for the permanent closure of this orifice is essential to the protection of the

internal ear and also the intracranial structures. It has been found that to attain the objects aimed at in the operation of ossiculectomy, the attic must be resected by the excision of its lateral (outer) wall. This may be done with a sharp-edged curette (Fig. 118G) or with mallet and chisel; in using the latter implements it is best to have the blows struck by an assistant, as the operator is likely to need both hands to properly direct and safeguard the cutting edge. To protect the facial nerve, the epitympanic space may be filled with cotton as a barrier between the chisel and the facial canal. At the close of the operation an incision at the site of the injection given to induce anæsthesia will obviate any danger from tumefaction or the possible formation of pus. The subsequent treatment comprises cleansing the wound with alkaline, antiseptic solutions and lightly packing the external auditory meatus with sterile, iodoform gauze, over which is placed a light, sterile dressing, which covers the auricle and is kept in place by a bandage. Exuberant granulations must be checked if they appear and all other details of management during convalescence must be regulated by the surgical principles applying to postoperative treatment.

The various diseases, which may develop as consequences of acute inflammation of the middle ear, or the chronic and suppurative manifestations of its morbid condition, are induced almost without exception by an intense and extended implication of the pneumatic cells which converge into the antrum, hence mastoid involvement constitutes a very grave consequence of otitis media and is always borne in mind as, at least, a possible result. When, despite the use of appropriate medicines and despite the operations just considered, the purulent otitis media persists, the suspicion that the mastoid cells are affected naturally arises and it is much strengthened by the supervention of any of the symptoms or physical signs, enumerated in Chapter XXXIII. As surgical operations upon the mastoid are a serious matter, not free from danger, conservatism dictates a reasonable delay, seven or eight weeks, during which persistent efforts are made to effect a cure by the use of both local and

general measures, medicinal and hygienic, while extirpation of the mastoid cells is held in reserve. This course is advised when the phenomena of the otitis indicate no urgency for a change in policy. The occurrence of certain symptoms is a warning to employ surgical measures at once. One of these symptoms is facial paralysis whose advent is of grave import. The loss of hearing for tones of high pitch accompanied by disturbances of equilibrium and by nausea or vomiting indicates that the labyrinth is being subjected to pressure and that mastoidotomy should be performed without delay to relieve that pressure. Either at the call of such emergencies or because a patient, conservative treatment has proved unsuccessful, surgery of the mastoid is our final resort. This must always have as a precedent condition, a free opening through the membrana tympani, which indeed has nearly always been made during the former treatment, but if it has not, or the aperture has closed, the matter must invariably receive attention before resorting to external incision. The cessation of the discharge in suppurative otitis media may be accompanied by a temporary increase in the deafness on account of the drying and stiffening of the drum-head. The patient should be warned of this possibility, or blame may be cast upon the treatment pursued. Inflation and massage should be used until the hearing returns. Sometimes a sequel of the disease is a permanent perforation of the drum-head (Fig. 119). This deformity seldom gives pain or causes tinnitus, but it impairs the hearing for tones of low pitch and also subjects the tympanum to injury by the entrance of deleterious substances from the external meatus. Occasionally deposits of chalk take place in the cicatrices following perforations, as shown in Fig. 120. Some of the orifices in the membrane may be surrounded by granulation and closed by a cicatrix, if their edges are lightly cauterized with silver nitrate or trichloracetic acid. If they resist treatment, the patient should protect the middle ear by a light packing of cotton in the meatus and should revisit the surgeon at intervals of two or three months for the removal of the crusts which

are apt to form upon the margin of the perforation. Efforts have been made to substitute an artificial drum-head for one which has been much damaged. The device most used is a circular disk of thin rubber to which is attached a wire extending to the conchal end of the meatus. This instrument often gives some help to the hearing, but it is by no means free from

FIG. 119.—Permanent perforation through Shrapnell's membrane: an instance of residual, purulent otitis media.

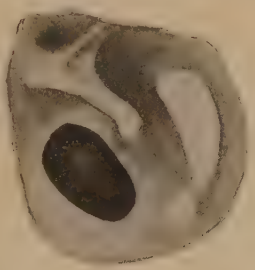


FIG. 120.—Permanent orifice and chalk deposits in drum-head caused by chronic, purulent otitis media.

danger and nearly, or quite, as much benefit accrues from pressing a small ball of cotton against the perforation, a method introduced by Yearsley in 1842. This pledget of cotton, if kept clean by frequent renewals and carefully inserted and removed, is unobjectionable and will probably accomplish nearly all in the way of improvement that can be attained.

CHAPTER XXXIII

MASTOIDITIS

The mastoid portion of the temporal bone called, for brevity, simply the mastoid lies directly behind the auricle and is considered a part of the middle ear, or at least associated with it in a functional as well as an anatomical way. The cavities existing within it all normally contain air and they are believed to play a physiological part in audition, but what this is has not been determined with certainty. Their rôle in the pathology of the middle ear is well understood and is most important. The mastoid, like other structures in this region, exhibits a great deal of anatomical variation, a fact which requires surgical procedures to be conducted with special caution. At birth this bone is simply an envelope inclosing a single air-filled cell, lined with mucous membrane, the antrum; all the rest is the product of development which continues through infancy and adolescence, and may not be complete until the age of full maturity. The descriptions hereafter given apply to the conditions usually found in persons of twenty years or more.

The upper border of the mastoid is in contact with the dura mater and forms part of the cranial floor; the posterior border articulates with the occipital bone and is penetrated by several foramina, the largest of which gives passage to the occipital artery and to a vein terminating in the lateral venous sinus; the lower border slopes to a conical projection, called the mastoid tip, which gives attachment to the sternomastoid muscle and is perforated from above downward by the stylomastoid foramen of the Fallopian canal, affording passage to the facial nerve which here emerges from the skull and proceeds forward to its distribution in the muscles of the face; the anterior border forms the osseous section of the external auditory meatus and parallel

with this margin in the substance of the bone is the Fallopian canal, referred to above. Upon the intracranial surface is a well-marked groove occupied by the sigmoid sinus.

The varied and often anomalous development of the mastoid has led anatomists to distinguish three structural types: the eburnated, with hard, dense bone and very few cavities; the diplöic, characterized by loose, porous tissue like that found between the two cranial tables; and the pneumatic, where there are many cellular spaces filled with air and the osseous tissue is somewhat scanty and appears to serve chiefly in forming the partitions between these pneumatic cavities. These variations exert a great influence upon pathological processes and necessarily modify therapeutic measures.

The mastoid cells are spherical or spheroid in shape, are lined with a nonciliated mucosa and histologically resemble the nasal sinuses (Chapter IX). Small tubules furnish communication with the antrum so that if a liquid be injected into one of the cells, it will gradually find its way into the others. The largest cavity within the mastoid and the only one that is never wanting is the antrum, located near the tympanum and opening into the attic. This cell lies at a depth from the exterior surface of the bone which frequently measures half an inch and sometimes even more, while the osseous partition separating it from the dura mater is often extremely thin.

Mastoiditis, or inflammation of the mastoid cells, is almost always secondary to suppurative otitis media, pus from the tympanum entering the antrum through the aditus and inaugurating a similar morbid process throughout the group of cells. It is said that the disease is sometimes primary, but this must be very rare and in such a case the isolation of the infection within the mastoid would be very brief, for the cells have no outlet except the aditus and their morbid secretions would speedily invade the tympanum and produce there an inflammation of identical type; so whether the movement be from mastoid to tympanum, or the reverse, the consequence is that in a very short time, both become involved and are conjoined as factors

in our therapeutic problem. For this reason, primary mastoiditis appears to have little beyond academic interest. The disease, as we habitually see it, arises during purulent otitis media, by the direct passage of pathogenic liquids into the antrum and other cells, probably also in some few instances, by infection through the vascular circulation.

The symptoms which accompany the invasion of the mastoid are pain, tenderness, muscular rigidity and pyrexia, often associated with alterations in the suppurative process already established in the tympanum. The pain is felt directly behind the auricle and is described as a deep-seated, severe, constant aching; it grows worse at night, bringing on insomnia with its depressing effects. Tenderness is present over the entire mastoid area and is elicited by deep pressure, particularly upon the tip of the bone. The tenderness is often of such intensity that the patient flinches when the hand approaches his ear. Where this symptom is so marked, its diagnostic value is great, for hardly anything except mastoiditis would produce it. Muscular rigidity is present when the lower part of the bone is much inflamed. There is often a large cell within the tip and its involvement affects the sternomastoid muscle, here attached, to such a degree that rotation of the head is difficult and painful. In uncomplicated cases, the pyrexia is not severe; the acceleration of the pulse is not more than twenty or thirty beats and the rise in temperature does not exceed two or three degrees, while thirst, anorexia and other febrile symptoms are slight, or even absent. Considering the serious nature of the local disease, the constitutional disturbance is surprisingly moderate. We see here a vivid contrast between this complaint and tonsillitis in which the systemic manifestations exhibit a severity very disproportionate to the intensity of the faucial disease. Extension of the morbid process from the tympanum to the mastoid affects the existing suppuration in ways that may indicate the diagnosis. When there suddenly occurs cessation, or notable decrease, in an otorrhœa previously abundant, we may suspect an involvement of the mastoid cells. If the

pus has been washed out of the tympanum and the thoroughly cleansed cavity fills up again very quickly, the conclusion is obvious that the purulent secretion comes from within the mastoid, because there has not been time enough for its production by the intratympanic membrane. It may be added that discharges from the mastoid cells are apt to be discolored by blood and putrefactive matters and to give out a foul odor, even in early stages of the inflammation.

As the only natural outlet of the antrum and its conjoined cells is through the aditus and tympanic vault, if by any means they be occluded, the incarcerated pus must make a way of escape. Sometimes it finds egress through the cortex of the bone whose substance has yielded to destructive ulceration. In such a case, the pus distends the overlying integument, forming a warm, fluctuating tumor which increases in size until the limit of cutaneous resistance is reached and there is spontaneous rupture at the weakest point. The passage of the pus through the cortex is accompanied by amelioration of the pain and other symptoms. This favorable turn in the course of mastoiditis occurs in those instances where the cortical layer of bone is thin, or has undergone some softening. When its firm texture resists the pressure of the imprisoned fluid, the purulent mass breaks through the thinner wall upon the intracranial side of the bone, causing extradural abscess, sinus thrombosis, meningitis, or cerebral or cerebellar abscess and sometimes general sepsis. The occurrence of such a rupture is often signalized by rapid rise in temperature, by dizziness, by nausea or vomiting and by the onset of delirium, or other psychic symptoms.

In mastoiditis the prognosis must always be guarded, because the morbid conditions are, to a great extent, hidden from view and can be judged by inference only and because the proximity of the brain and the weakness of the structural barriers, which protect it from invasion, constitute a feature of grave danger. Very much depends upon judicious treatment and especially upon the discretion used in determining just when surgical interference is necessary and just what form that interference

shall assume. Nothing can be ordinarily foretold as to the duration of the disease; the number of indeterminate factors is so large that they render unwise any attempt at prediction.

The inaccessibility of the mastoid cells is a cogent argument for surgical measures. The fact that their natural entrance affords hardly any chance for either examination or treatment, is surely a very good reason for making an artificial entrance which will enable us both to see and to act. This, in my judgment, is truly conservative surgery, and yet there is a period at the very beginning of mastoid inflammation, when it is possible to bring about resolution, or termination of a suppuration that is only incipient. In using nonsurgical measures for this purpose, the thing which demands the best judgment and the closest discrimination is to determine just when it is our duty to lay aside other things and take up the knife.[1]

When the decision is made to employ the antipyretic method of treatment, all its resources must be brought to bear at once, for at best it offers only a chance of success and its tardy or partial use may serve only to convert this chance into the certainty of failure. Accordingly, the patient must be kept in bed, given a warm bath and a brisk saline cathartic, followed by use of a milk diet and free drinking of pure water. The best attainable drainage must be given the tympanic cavity and, if required to accomplish this, the incision through the membrane previously made must be enlarged; in addition the meatus and tympanum are to be irrigated with a saturated solution of boric acid of moderate warmth, not only to wash away the accumulated pus, but to encourage its flow from the antrum and aditus. The dizziness produced by warm injections, when the patient is

[1] When antecedent medicinal treatment appears to be for the patient's good, its adoption is favored by another reason. At the present time prosecutions for damages supply the only pabulum of a large number of lawyers who accordingly are persistent in fomenting suits for malpractice. If a mastoid operation results unfavorably, the surgeon is liable to be held responsible, unless he can prove that it was not only well performed, but was absolutely necessary. The fact that medicinal treatment was faithfully tried, before the resort to surgery, is a strong point in the defence. Upon the ground of self-protection, it may prove to have been a most judicious precaution.

standing or sitting, is very much lessened in the recumbent posture and may be altogether absent. To check the tendency to suppuration and gain time for the effects of the constitutional treatment, we rely on the topical use of cold, applied either by an ice bag, or by Leiter's coil through which ice-water passes slowly, producing on the surface of the tube a temperature of about 36° F.[1] In nearly every case these antipyretic measures will cause an amelioration of the symptoms, but this may be misleading, as it occurs when the local disease is arrested and also when it is not; in the latter case the mitigation proving only temporary. Mindful of this important fact, the ice bag or coil should be removed at the end of thirty-six hours and the irrigations suspended, careful note being taken of favorable changes in pain and tenderness. If after the lapse of two or three hours, a further improvement be observed, we conclude that resolution is taking place and resume the treatment, but if deep pressure shows a return of the hyperæsthesia and the patient complains of more pain, there is but one interpretation for these symptoms: the mastoiditis has been insidiously advancing all the time and our apparent gains have been due, not to control of the local morbidity, but simply to constitutional sedation. The condition now confronting us is a signal to stop, a signal as imperative as the red lantern waved before a moving train, and it signifies—drop the antipyretic treatment and operate.

In view of the fact that such a course may become mandatory in any case, it is the part of wisdom to have the preparations for the operation made in advance, both as to the assistants needed and the instruments required. The exhibit in Fig. 121 shows everything that is at all likely to be needed in the operation done with the technique which I consider the best, some of the instruments being used only to meet exceptional requirements. The surgeon encounters no difficulty in choosing an

[1] Many authors advise the local abstraction of from one to three ounces of blood by the application of leeches behind the auricle; some preferring the living worm and others the mechanical substitute, or artificial leech.

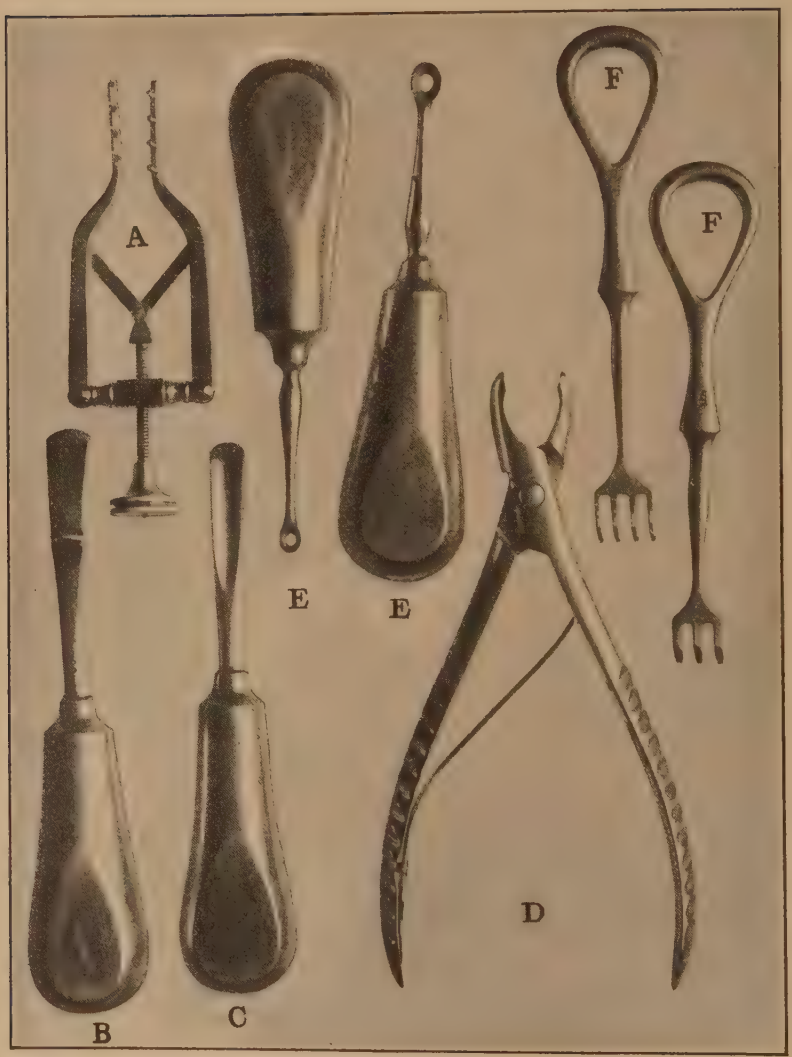


FIG. 121.—Instruments for simple mastoid operation. (Schwartze.) *A*, Allport's mastoid retractor; *B*, periosteal elevator; *C*, Randall's gouge; *D*, Hartmann's mastoid rongeur; *E*, McKernon's mastoid curettes; *F. F.*, Volkman's retractors

operation, because that devised by Schwartze has won an approval that is almost unanimous, as following the golden mean between what is incomplete and ineffective upon one hand, and what is too radical and destructive upon the other. It was formerly the practice to evacuate purulent accumulations by making a small perforation into the antrum. This palliated the symptoms, for the time being, by lessening pressure and withdrawing some of the pus, but it left the pyogenic lining of all the cells in a morbid state and hence was followed by long-continued suppuration, frequently leading to necrosis and to intracranial infection. Schwartze pointed out the necessity of fulfilling in this disease the requirements emphasized by the laws of asepsis which insist upon the removal of all morbid tissue as an indispensable antecedent to repair and recovery. The method he introduced is designed to accomplish this and, at the same time, leave undisturbed all organs which appear to be normal or only functionally affected. In favorable cases, this operation leads to a permanent cure of the mastoiditis with only a slight impairment of the hearing and no continuing damage to the general health.

As the surgeon may encounter conditions which will necessitate contact with the brain, a specially careful asepsis is enjoined in this operation. Sterilization of the hands and wrists of the operator and his helpers and also of all instruments and dressings must be thorough. All hair is to be shaved from the operative area and from a two-inch margin surrounding it and the integument scrubbed first with soap and water and then with ether and alcohol; finally the side of the head is protected, up to the moment of operation, by a covering composed of several layers of gauze wet with a solution of mercury bichloride, 1 to 5000. The position of the surgeon is at the head of the operating table on which the patient lies upon his sound side, his face turned toward the anæsthetizer, his vertex toward the operator and his occiput toward the assistant.

General anæsthesia having been induced, the primary incision is made with a scalpel and has a curviliner course, beginning at

the tip of the mastoid process and continuing upward, a quarter of an inch behind the auriculo-mastoid groove, to a point perpendicularly above the orifice of the external auditory meatus. During this procedure, the auricle is drawn forward and downward by the hand, just enough traction being made to keep it out of the way. Free bleeding from several minor vessels follows this first incision, but is readily controlled with hæmostats which are left in place till the operation is finished. The layers of the integument divided to the surface of the periosteum are drawn forward and backward and held by rake-shaped retractors. The anterior flap, carrying with it the auricle and part of the cartilaginous meatus, is easily retracted, as it has a convex margin, but the posterior flap, whose border is concave, may present some difficulty. This is obviated by a short horizontal cut at right angles to the former incision and near its center, where the constriction is greatest.

The next step is to divide the periosteum along the course of the former section and to lift it from the bone with an elevator. In making both incisions the temporal fascia is carefully protected from injury and, when the osseous surface has been fully exposed, the periosteal flaps are turned to each side and, together with the overlying integument, held away from the area of operation by an automatic retractor (Fig. 121A). The surface brought into view is the mastoid cortex upon which, as a guide, we suppose there is a trianguloid figure drawn with the following outline: the first side follows the incision, extending from the mastoid tip along the rear wall of the osseous part of the meatus, up to the supermeatal crest; the second side follows the crest backward from this point and the third side is a line joining the other two, as shown in Fig. 122. This trianguloid is the base of a pyramid at whose apex is the antrum. The task of surely and safely opening this chamber has stimulated the invention of instruments, a complete assortment of which would be large and costly. There are mallets and chisels, conical drills and burr drills, the Russian perforator, a rasping drill rotated by electricity and others beside. I have not used

any of these instruments for a long time, because I find the work can be done more satisfactorily by one simple and inexpensive implement. This is a steel gouge, six inches in length, made in one piece, and having a heavy bulbous handle affording a firm grasp (Fig. 121C). It has a short shaft terminating in a curved cutting edge which is bevelled upon the upper, concave

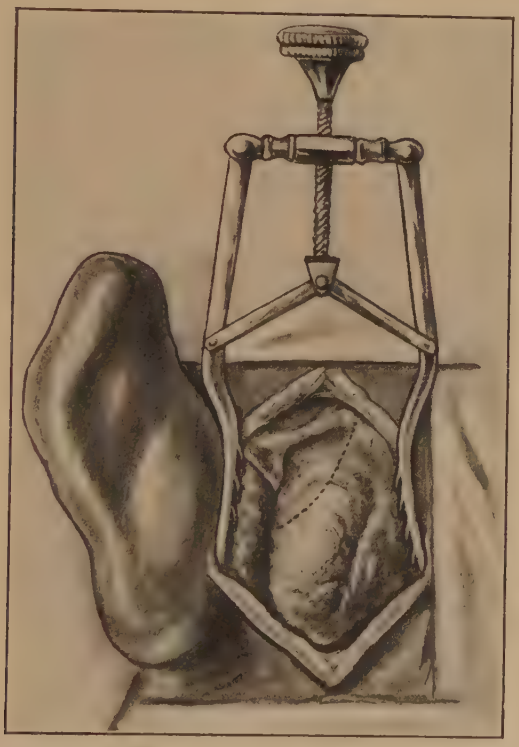


FIG. 122.—The cortex of the mastoid exposed. Trianguloid figure serving as a guide in penetrating to the antrum.

surface, but straight upon the lower side which is convex. As this gouge is pushed forward, the convex side is in contact with the bone and the edge removes thin chips. It cannot go too deep, because the surgeon's index-finger rests in the groove of the shaft close to the cutting edge and serves as a constant guard against dangerous penetration. This precaution is an

admirable feature of the instrument and the position of the finger is shown in Fig. 123.

The bone is removed little by little, starting near the lower portion of the trianguloid figure and working upward, forward and inward, until a conical excavation is made and the gouge opens a cavity at the bottom of this pit. The distance of this

FIG. 123.—Proper position of the finger guarding the edge of Randall's mastoid gouge.

cavity from the cortex is usually ten or fifteen millimeters. The breaking of the wall may be attended by an outflow of pus which has been incarcerated under pressure and, when this is considerable, the inference is that the cavity opened is the antrum; indeed the method detailed reaches the antrum in a great

majority of cases, but occasionally the gouge may first penetrate some contiguous cell and, to arrive at certainty, a thin silver probe, bent near the end, should be passed into the opening just made and its point directed toward the tympanum. If it enters the attic we are assured that it has passed through the antrum upon its way thither. Should the first cavity opened prove to be a cell, the antrum will be found by a little further excavation. The work of the gouge is supplemented

FIG. 124.—The antrum and mastoid cells converted into one cavity with two openings. Schwartze operation.

by the use of rongeur forceps (Fig. 121D) with which the rest of the cortical layer of the mastoid is cut away and all spicules of bone removed. The breaking up of the cells and the thorough ablation of all diseased tissue and all morbid products is then effected with sharp curettes (Fig. 121 EE). When this work is finished, there will be within the mastoid a single cavity of variable size and shape which, if the integrity of the cranial partition has been maintained, will have two openings, one made by the operation and the other the natural passage to the tympanum (Fig. 124). Sometimes a large cell is located in the tip

and pus burrows downward into the digastric fossa. In this condition, termed Bezold's mastoiditis, the tip must be extirpated and aseptic treatment employed with drainage from both the upper and lower incisions; after which the somewhat extended incision along the neck is closed by sutures.

Great care is taken to avoid wounding the facial nerve which descends through the Fallopian canal across the anterior part of the mastoid to the point of its emergence at the stylomastoid foramen, and also not to break the partition dividing the mastoid cells from the lateral sinus. If this mishap occurs, a gauze plug may be inserted till the operation is complete, when the ruptured spot can be covered with a pad retained in place by the antral packing. Extradural abscess, sinus thrombosis, meningitis and brain abscess are complications which may be discovered during the operation and, when found, demand immediate treatment. See Chapter XXXV.

After all deleterious substances have been removed from the cavity remaining within the mastoid, the raw surface should be irrigated with a solution of mercury bichloride (1 to 5000), and a gauze packing introduced both as a means of drainage and to promote healthy granulation. The periosteum is then replaced and the incisions closed by interrupted sutures, a sufficient space near the center being left unsutured to afford command of the drainage and provide for the removal of the packing when it is no longer needed. If exuberant granulations appear they should be reduced with a solution of silver nitrate: ℥j to fl. ℥j, or snipped off with scissors, a procedure which is not painful.

Another method of postoperative treatment consists in cleansing the cavity as already described, and then allowing it to fill with blood, the capillary flow being incited by very gentle friction of the denuded surfaces. This blood coagulates and over it the tissues are replaced and sutured, an aperture filled with a wick of gauze being left at the lower margin of the wound. In favorable cases the clot becomes organized and serves as a matrix for the deposition of other reparative material,

shortening the time required for recovery and improving the appearance of the region after convalescence is complete.

The process of repair after the operation is usually slow and during this time the operative area must be protected by a light covering of sterile gauze, kept in place by a roller bandage or by a well-fitting cap of linen or muslin. We cannot regard the cure as accomplished until healing is perfect at every point, and there is entire cessation of pain, tenderness and ottorrhœa.

The radical mastoid operation has developed from the procedure which was devised by Stacke, and the modification, perfected by much experience and now very generally preferred, is termed the Stacke-Schwartze operation. It requires both caution and skill, for the brain and lateral sinus are in close proximity and the surgeon cannot know in advance whether the protective anatomical barriers are intact or not. As most of the auditory conducting mechanism is removed by the operation, it leaves only a fraction of the functional power of the middle ear. Nevertheless if the internal ear remains normal, there may be improvement in the hearing actually possessed by the patient, due to removal of diseased and necrotic structures which had not only lost all functional value but were an obstruction to the atmospheric vibrations reaching the tympano-labyrinthine wall. But conservation of the hearing is a secondary motive for the radical operation, its main purpose being to avert the danger of intracranial disease or general sepsis caused by an injurious suppurative process which has proved refractory to other treatment. It is therefore indicated in cases where medicinal measures, ossiculectomy and the simple mastoid operation have failed to effect a cure, and also in those which have progressed to a late stage without operation, and exhibit a combination of grave morbid conditions. These conditions include the presence of cholesteatomata, of polypi, of recurrent exuberant granulations, of fistulæ in the osseous portion of the meatus and of suppurative labyrinthitis.

The preparation of the patient, the anæsthesia and the posi-

tions of the surgeon and his assistants are the same as in the Schwartze operation and the instruments suited to the procedure are shown in Fig. 125.

The primary incision begins at the mastoid tip and extends upward over the course already described in the Schwartze technique, but is carried further to a point a little behind the temporal artery. Above the superior pole of the external auditory meatus the cut goes no deeper than the temporal fascia, but from this point downward to the tip, it extends to the bone, thus exposing to view the mastoid cortex. The cutaneous and periosteal layers are deflected from the line of incision and held out of the way. The next step is to separate from the superior and posterior walls of the bony meatus the skin and periosteum with a blunt-edged dissector (Fig. 125I) all the way to the membrana tympani or, if it has been destroyed, to the tympanic ring, and to have them properly withheld by retractors (Fig. 125G). As the auricular flap made by the primary incision carries with it the cartilaginous portion of the meatus, it is now possible to inspect the canal and the tympanic cavity quite fully by rays of light reflected from the head mirror and to determine what is morbid and what is still normal throughout the space.

The antrum is uncovered and entered by the technique already detailed (Schwartze operation) and rongeur forceps (Fig. 125D) employed to cut away the superior-posterior wall of the osseous meatus. For the protection of several delicate structures—the facial nerve, the intratympanic prominence caused by the horizontal semicircular canal, the round window and the oval window with the implanted foot of the stapes—some operators use the Stacke protector (Fig. 125J) which is introduced through the antrum so that its curved extremity passes through the aditus into the attic and serves to shield from injury the structures enumerated. By the procedures which have been described, the antrum, aditus, attic and cavum tympani are converted into a single cavity, larger than the combined chambers which it replaces, because at different points osseous and

other tissues have been ablated (Fig. 126). A hawk-bill curette (Fig. 125L) is now inserted to ablate the scutum and to remove

FIG. 125.—Instruments for the radical mastoid operation. (Stacke-Schwartze.) *A*, Allport's mastoid retractor; *B*, periosteal elevator; *C*, Randall's gouge; *D*, Jansen's mastoid rongeour forceps, double curve; *E, E*, McKernon's mastoid curettes; *F,F*, Volkmann's mastoid retractors; *G*, Neumann's auricular retractor; *H*, Hartmann's mastodi rongeur; *I*, Allis's blunt dissector; *J*, Stacke's mastoid protector; *K*, Randall's extra-dural curette; *L*, Randall's hawk-bill curette; *M*, Randall's jugular bulb curette.

all necrotic bone and diseased tissue, together with whatever products of morbid action may remain in the field of operation.

The inside of the tympanic orifice of the Eustachian tube is scraped with the small curette upon one end of the hawk-bill instrument and this curettement requires caution, as the internal carotid artery lies in close proximity.

The remaining steps of the operation have reference to recovery; their purpose is to secure repair of the lacerated structures with a minimum of deformity and to preserve whatever remnants of functional power still exist. The cartilaginous part of the external auditory meatus is slit through its posterior side from the concha to its other end, where it joined the osseous

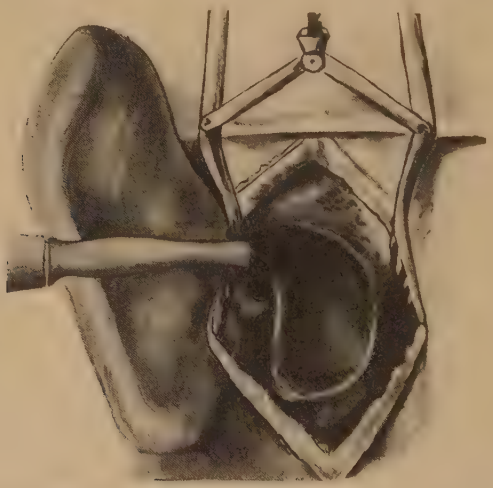


FIG. 126.—The antrum, tympanum and intervening cavities are converted into one. The auditory canal is held by Neumann's retractor.

part, the line corresponding with the longitudinal opening already made in the bony section of the canal (Fig. 127). At right angles to this slit there is made a short incision separating the concha and meatus. In this way are formed two rectangular flaps, comprising all layers of tissue belonging to this portion of the meatus (Fig. 128). If in any part these flaps are too thick for the position they are designed to occupy, the cartilaginous layer may be shaved away; but the skin must be preserved, as it is the essential thing in the plastic results desired.

After bleeding has been stopped and any necessary ligatures applied, the cartilaginous part of the meatus is implanted into the bony portion, the flaps coming into apposition with the denuded surfaces of that section of the canal and also with the borders of the antral cavity as enlarged by the operation. The skin flaps thus cover a part of the raw tissue and also, by their proximity, encourage the growth of a cutaneous covering over

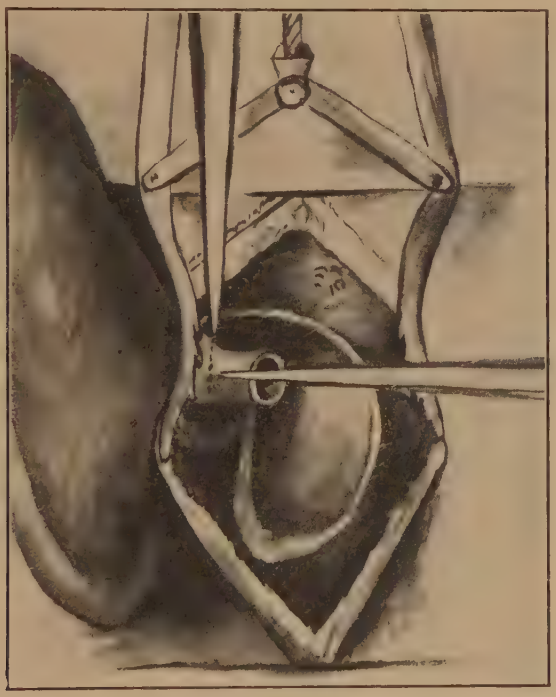


FIG. 127.—Slitting of cartilaginous part of the external auditory canal.

the contiguous granulating surfaces. They are retained in the correct position by a tampon of iodoform gauze, reaching from the concha to the tympano-labyrinthine partition and so packed as to snugly fill the canal and keep it in proper shape. The cavity in the mastoid is filled with a similar packing of gauze and the membranes, cutaneous and subjacent, which were de-

flected by retractors, are replaced and their edges sutured, a sufficient space being left for a protruding wick of gauze to provide for efficient drainage. In the absence of untoward symptoms, the meatal tampon should be left undisturbed for several days; it is through the rear wound that most drainage occurs and the anterior dressing is required chiefly to maintain

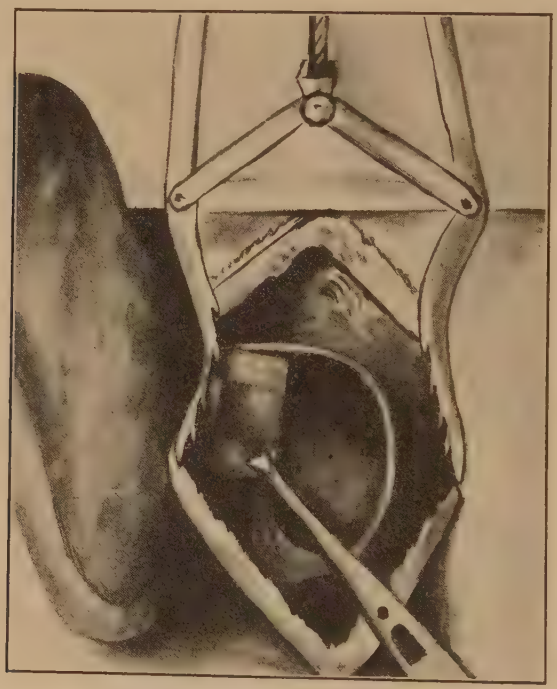


FIG. 128.—The formation of rectangular flaps for plastic repair of the external auditory meatus. Stacke-Schwartze operation.

the structures in normal position and to promote their uniform nutrition during the process of repair. When the operation itself has proved satisfactory and convalescence is free from accident there is often left a perception of sound which, while small, is far better than absolute deafness and the caleidic result is, in many cases, surprisingly good as occurring after an operation of such gravity, as is the radical mastoid. If a natural

posture of the auricle has been maintained through convalescence, the disfigurement is almost wholly near the postauricular groove where it can be covered by a skilful disposition of the hair, so that by a well-arranged coiffure women are able to conceal every trace of the deformity.

CHAPTER XXXIV

OTOSCLEROSIS

In discussions of otosclerosis there has been considerable ambiguity, because authorities differed as to what are the essential features of the disease and what are only coincident conditions. At the International Otological Congress recently held in Boston, efforts were made to reach an agreement and, as a result, we may describe otosclerosis as a chronic, morbid process causing permanent porosis of the bony capsule of the labyrinth with the formation of intraosseous cells and with partial or complete ankylosis of the stapes and framework of the fenestra ovalis; also atrophy of the nerve terminals in the membranous labyrinth, while the Eustachian tube continues patulous and the membrana tympani normal. Its chief symptoms are gradually increasing deafness, persistent tinnitus, psychic depression and intermittent pain, which is not generally severe. On account of increased vascularity, the promontorium assumes a red color and this is seen through the membrana tympani at the site of the umbo. This sign is sometimes absent; when present, it has much diagnostic value.

Two views are held regarding the pathology. One is that the morbid condition begins in the middle ear and extends by way of the blood vessels to the medullary spaces of the osseous labyrinth, causing inflammation of a rachitic type, which involves the stapediovestibular articulation and may affect all the joints in the ossicular chain. The other opinion is that the disease starts in the bony labyrinth by the interposing of periosteal cells in the Haversian canals; that the original bone substance is absorbed and its place supplied by a structure that is of harder consistence and incorporates many minute cavities, an alteration which has been termed spongification. The mor-

bid changes, whatever their origin, render the labyrinth less and less able to perform its functions and, in accordance with the part affected, destroy the power of hearing or that of maintaining equilibrium.

The etiology of otosclerosis is in doubt; but causes of a local origin play a very subordinate part. Some cases have been reported where the disease followed traumatism but such instances are rare and, even in the few recorded, it is possible that the trauma was merely antecedent, not causal. The disease is nearly always bilateral and occurs much oftener in females than in males (the Münich statistics show a ratio of two to one). Many otologists claim that heredity is an important etiologic factor, but this is denied by others of equal authority. A consideration of all the facts leads to the conclusion that the disease has some predisposing cause which is constitutional, not local. What that cause is we do not know. Some authors lay the responsibility upon neurasthenia, others upon the rheumatic and gouty diathesis, but the majority who propose an etiologic, theory, bring forward the conventional scape-goat, syphilis.[1] Considering the protean forms in which the venereal disease manifests itself, perhaps they are right; but the morbid anatomy of otosclerosis differs so much from that of the familiar syphilopathies that the suggestion receives little support from analogy. It is worthy of further investigation, yet its bearing on the condition of any patient belongs to the esoterics of the medical profession for even the slightest intimation that an individual's deafness is due to syphilis may have evil consequences.

The onset of this disease is so insidious that it has usually made considerable progress before the patient's attention is directed to it and it comes under professional notice; hence we know hardly anything of its exciting causes. Whatever they are, they do their work unobserved and the period of their activity is not remembered. Many authorities agree that certain

[1] The ancient adage calls war the last argument of kings (bellum, ultima ratio regum) and one might well add a new proverb to the common stock, by saying that—Syphilis is the final etiologic conjecture of pathologists.

conditions aggravate the symptoms but that is quite a different thing from causing them. During the course of the disease, exacerbations are liable to accompany attacks of the infectious fevers, and many other acute maladies, also parturition and the puerperal state. To this list the German authors add sexual intercourse. The special severity of the symptoms declines with the subsidence of the cause which produced it, but the patient does not regain his former status; he suffers permanent detriment; the deafness is somewhat worse than before; the tinnitus more annoying; hence every precaution should be taken to prevent these exacerbations.

Otosclerosis exhibits some peculiar features, which though at present inexplicable, may in the future throw light upon its real nature. Its insidious beginning is usually in the period between twenty and fifty and, unlike the majority of diseases, its prognosis is worse in the younger subjects, in whom recuperative power is greatest. In persons who are not attacked until the decline of life, progress is apt to be very slow and to be interrupted by long periods of quiescence. In this paradoxical feature it resembles diabetes. The progressive deafness is often associated with the curious phenomenon termed paracusis Willisii, the ability to hear better in a noisy place, like a railroad car, or crowded street, than in a quiet room. The tinnitus, which is frequently very distressing and may lead to melancholia of the suicidal type, has strange peculiarities: a patient who had never seen a great waterfall and tried vainly to explain a subjective noise, which she heard habitually at night, made a visit to Niagara Falls and at once recognized the roar of the cataract as identical with the sound which had long distressed her. Sometimes a nervous shock brings a total and permanent cessation of the tinnitus, a thing so incredible, if the symptom was due to structural change in bone, that it casts doubt upon the diagnosis. Giddiness, staggering, nausea and vomiting; symptoms signifying disorder in the static labyrinth; are observed in some cases, but they are rare as compared with the surdity and tinnitus referable to disease of the cochlea and other parts of the

acoustic mechanism. The authorities sapiently "explain" this by saying that the auditory labyrinth is more vulnerable than the static labyrinth, which is no explanation at all, but only a restatement of the phenomena in different words.

The diagnosis is made by a process of exclusion. When a patient shows impairment of hearing for the tones of low pitch, combined with tinnitus, the middle ear is examined. If the Eustachian tube is patulous, the integrity of the drum-head preserved and the mastoid normal, the conclusion is obvious that there is trouble with the ossicles or the labyrinth or both. When upon further examination we discover fixation of the foot of the stapes and that the auditory defect applies to tones of high pitch, as well as low, we have a combination of symptoms and physical signs pointing to otosclerosis and their significance is emphasized by the absence of symptoms pathognomonic of labyrinthitis.

The prognosis, as it concerns life, is favorable, fatal terminations occurring only in a few cases where the distress over loss of hearing and the depression caused by uncontrollable tinnitus has led to insanity. In regard to hearing, the outlook is gloomy. Many believe that the disease advances at a variable rate and with intervals of quiescence, until it wholly destroys the sense of hearing, and that treatment can do nothing more than retard this advance and prolong the periods of remission. Hence they advise an early recourse to instruction in lip-reading. A less pessimistic view is held by Bezold, whose opinion has special value, as he has probably seen more of the disease than any one else, having observed more than a thousand cases during the years from 1880 to 1905. He is sceptical as to treatment and thinks that the damage done to the labyrinth is always beyond any possibility of repair, but he believes that in a majority of cases the morbid action stops spontaneously at a point short of absolute surdity. The patient is very hard of hearing and can engage in conversation only by the aid of an audiphone, but he is not "stone deaf," and the remnant of audition he possesses when the arrest of the disease occurs, that remnant he retains

for the balance of his life. There is even an apparent improvement due to the tolerance established in this, as in many other conditions, where recovery is impossible, also to practice with the audiphone bringing skill in its use and hence better results. So it comes to pass that, although acoustic tests show none of the lost auditory power to have been recovered, the patient actually gains in facility for communicating with his fellow-beings and, in that sense, really improves. Bezold very wisely lays stress upon the great influence such a hope exerts upon the mind, when it comes with the authority of a trusted physician. To one who fears the total loss of a special sense, even this expectation is a boon.

Among the therapeutic measures recommended, either to palliate symptoms, or to retard the advance of the disease, sojourn or residence in the mountains has had many advocates, who claim that the rarefied air and other climatic conditions found in elevated regions are positively beneficial. Other observers assert that, aside from the encouragement following change of scene and novel experiences, there are no appreciable results. Mechanical treatment, which maintains the motility of the ossicles by giving them exercise, has been strongly advised by those who believe that such exercise will prevent the ankylosis of the foot of the stapes in the oval window, one of the detrimental organic changes caused by the disease. The exercise movements are produced by the Delstanche rarefactor which causes an alternation of positive and negative atmospheric pressure or by the Lucae aural probe with cup-like extremity, which applies force to the short process of the malleus imbedded in the membrana tympani, whence it is transmitted to the other ossicles. The mechanical treatment is endorsed by able otologists and condemned by others of equal standing. Among medicines which have proved useful are potassium iodide and mercury, given for their alterative effect and to combat any syphilitic influence possibly existing: thyroid extract and small doses of phosphorus ($\frac{1}{200}$ grain) have the recommendation of some authors, but the remedy which has the most positive

testimony in its favor is pilocarpine. At an early stage of the disease, when there is congestion and active histogenesis, the depletory effect of this powerful sudorific appears to positively retard the morbid changes and sometimes even arrest them. It must be administered in doses large enough to show its physiological effects to a mild degree.

I think that otosclerosis is much less prevalent in this country than upon the European continent. This opinion is founded on my personal observation and on the paucity of American statistical reports. Our authors generally base their consideration of the subject upon Continental experience and refrain from giving tabulations or percentages of their own work, creating the impression that the number of cases is too small to justify generalizations. The statistics found in the text books have been collected and compiled chiefly by the otologists of Switzerland, Austria and Bavaria. A very useful service can be rendered by some one who will devote the time to gather from our hospital and dispensary records all information relating to this disease. These data would furnish a basis upon which to calculate its proportional frequency in the United States. If its ratio to population should be found much less than in central Europe, we would have a starting point for inquiring what differences in national environment produced the difference in prevalence and, from this, might proceed to a discovery of many things which have so far eluded search and have made otosclerosis one of the enigmas of modern medical science.

CHAPTER XXXV

INTERNAL EAR DISEASES

The elaborate and complex mechanism of the internal ear, or labyrinth, has proved a very difficult subject of study from both the structural and functional standpoints. The early anatomists classified everything here found as comprised in the organ of hearing and the physiologists of like date assigned to the different parts various conjectural functions, all connected with the special sense of audition. The progress of knowledge was gradual and it is only in recent times that we have positively learned that the labyrinth has two functions which are distinct and widely different. The power of sound perception centers in the cochlea, which is connected in the closest way with the conducting mechanism of the middle ear: the semicircular canals perform a wholly diverse function which concerns the body's relations to space and motion, particularly the maintenance of equilibrium. The use of some accessary portions of the labyrinth is still in doubt, but it is presumed that they play a part in connection with one or other of the two well-recognized functions. The terms auditory labyrinth and static labyrinth have been generally adopted as descriptive of the two parts of the organ; the first signifying the cochlea and whatever is in physiological coöperation with it; the second the semicircular canals and any auxiliaries they possess.

The study of these parts is beset with very great difficulties. No one has ever seen a healthy, normally functionating labyrinth. We may dissect the inert mass taken from the cadaver; we may look at a diseased, necrotic remnant exposed to view by a lacerating procedure, which violently interferes with the physiological processes; but these are very different things from the labyrinth in its normal state, instinct with vitality and perform-

ing functions of the greatest delicacy. Of this we have no direct observation: we form a mental picture and can do no more, for the thing itself is concealed and inaccessible. Despite these hindrances there has gradually accumulated a body of facts which furnish a rational basis for the consideration of labyrinthine diseases and are not lacking in practical utility. One of the most important facts is the high rate of mortality following acute diseases of the labyrinth, ranging from sixty to ninety per cent. This extraordinary fatality is not due to the primary attack *per se;* for when the morbid process is restricted to the internal ear, the death rate is not high, but to the great liability of the labyrinthine disorder spreading to the meninges and the parenchyma of the brain. On this account when the labyrinth is attacked, endeavors to preserve the hearing are quite overshadowed by efforts to save life and our attitude is very different from what it is in diseases confined to the middle ear.

Labyrinthitis is a general term covering the varied inflammatory affections of the structure and comprehends the circumscribed, the diffuse serous and the diffuse purulent forms of the disease, which are not separated by any definite boundaries, but merge into each other. Etiologically these disorders are very rarely primary, nearly all being secondary to disease of the middle ear. Sometimes they follow an acute, purulent otitis media, particularly one originating in scarlet fever. In these instances the infecting germs passing from the tympanum into the labyrinth are virulent and rapidly destroy not only the functional power, but the osseous and other tissues of the internal ear. Such cases, however, constitute a small minority, by far the larger portion taking place as a result of purulent otitis media in its chronic form, frequently after a continuance covering years. Here the labyrinthine malady itself develops slowly and insidiously. The avenues by which infection gains access are the oval and round windows, necrotic orifices in the osseous partition and especially fistulous openings in the horizontal semicircular canal. Tuberculosis and cholesteatomata play a part in a considerable number of these inflammations,

by inducing a slow, but progressive destruction of the bony walls protecting the labyrinth.

The symptoms, so far as they are referable to the auditory labyrinth, are not very significant, except the deafness. There is some pyrexia, particularly in connection with suppuration; but the fever is too slight and variable to be of much value in diagnosis. The same description applies to the pain and tinnitus. Their character is not sufficiently definite to prove the locality of the disease, especially as both of them occur in chronic, purulent otitis media, with which labyrinthitis is nearly always intercurrent. The surdity alone is a positive diagnostic sign. When one suffering from inflammation of the middle ear experiences a sudden and notable increase in his deafness; or when, after the radical mastoid operation, the remnant of sound perception, which is retained, becomes suddenly extinct, there is strong probability of labyrinthitis and the aural tests, which discriminate between the audition of tones of high and those of low pitch and between the perceptive and the conducting mechanisms, should be employed. The application of these tests, described in Chapter XXVIII on Aural Examinations, furnishes whatever information is procurable from the auditory labyrinth except that in patients who have undergone the radical mastoid operation, bringing into plain view the tympano-labyrinthine septum, active suppuration, overfilling all the cochlear region, may be manifested by pus impelled outward through fistulous orifices and showing itself on the exterior side of the partition. Such an occurrence, of course, clears up all doubts regarding the character of the morbid process.

There is a group of symptoms referable to the static labyrinth which have a dual significance. First, their presence indicates (probably) a morbid condition of the semicircular canals and, second, implies involvement of the auditory mechanism because the static labyrinth is much less vulnerable than the other and, if it has given way to disease, we infer that the aural apparatus is even more seriously affected by the same morbid influences. The symptoms alluded to are giddiness, nausea or

vomiting and difficulty of maintaining equilibrium, especially in standing and walking. These things signify disorder in the semicircular canals, provided they are properly assignable to the labyrinthine region. That proviso raises a question which leads to a new phase of the subject. Nausea and vertigo may be due to causes foreign to the internal ear, *e.g.*, to certain gastric disturbances; hence the question arises in each individual case whether these symptoms are traceable to the semicircular canals. To decide this question, we resort to the production of nystagmus, a phenomenon of peculiar kind, which has excited great interest during the past decade and is a novel phase of otologic study attracting at the present time probably more attention than any other of the new subjects. So far as this phenomenon is used to decide whether the symptoms (vertigo, nausea, etc.) originate in the labyrinth or elsewhere, the matter can be disposed of in few words. When the semicircular canals are normal, certain stimulants excite nystagmus of a definite and well-recognized kind. This result does not follow if the canals are disabled by disease. Therefore, when a patient has vertigo or other suspicious symptom the stimulus is applied, and if it excites a normal nystagmus we infer that the vertigo is not of labyrinthine origin, but is caused by disorder somewhere else. If the normal response does not appear, we may often infer that the fault is in the static labyrinth.

The word nystagmus signifies a rolling or rotation of the eyeball. The ball is suspended in the orbit in such a way that this rotation may occur in any one of the three planes of space, and the ocular muscles, such as the adductor, abductor, patheticus and others, supply the traction to produce these forms of rotation. The semicircular canals of the labyrinth are located very nearly in these three planes. The horizontal canal occupies the position indicated by its name; the superior canal is vertical in direction and is placed transversely to the long axis of the petrous portion of the temporal bone, on the anterior surface of which its arch forms a round projection; the posterior canal, also ver-

tical, is directed backward nearly parallel to the posterior surface of the petrous bone.

When the contents of the normal semicircular canals are subjected to excitation, there is induced a series of neural impulses, which cause movements of the eyes, and among these movements there is one quick rolling motion succeeding each form of excitation, a motion more conspicuous than the others. This quick motion is a rotation in the horizontal, or in one of the vertical planes, and its characteristics designate the form of nystagmus incited by that particular excitation. Thus, if a certain excitant causes both eyes to rotate upon their axes, toward the left, in the horizontal plane, we say that excitant produces binocular, horizontal, nystagmus to the left.

In considering the various excitants and the ocular rotations which follow their use, a clear distinction must be made between the facts, the observed phenomena, and the theories constructed to explain those phenomena. The facts are well authenticated by many careful observations and it is with the facts that the clinician is chiefly concerned. There is a spontaneous nystagmus, whose nature has been minutely studied by neurophysiologists; but for diagnostic purposes the artificially excited nystagmus is generally used, because our ability to control it renders its manifestations more uniform and hence more instructive. The methods of artificial production comprise the caloric test, the rotation test and the mechanical test (in the presence of fistula). There has also been discovered a galvanic reaction, when the electrotonus is disturbed; but it is merely corroborative of the results given by the other methods. The caloric test is the most sensitive, that is to say, the response which it elicits from a normal labyrinth is suppressed by a milder disease than other responses. It is performed by syringing the external auditory meatus with water at two temperatures, separated by an interval of forty-five thermic degrees F. When the temperature of the water is 115° F. its injection is followed by a nystagmus to the same side as that upon which the syringe has been used and when the temperature of the water is 70° F. there

ensues a nystagmus to the opposite side. The temperature of the warm and cool water is from 15° to 30° above or below the normal standard of the body, but the actual thermic change in the semicircular canals is considerably less than on the surface of the membrana tympani, on account of loss during transmission through the intervening structures.[1]

In the rotation test the whole body, either erect or in the sitting posture, is turned around ten times, all the whirls being in one direction. After the motion ceases there is nystagmus to the opposite side. A special chair devised for making this test is shown in Fig. 129.

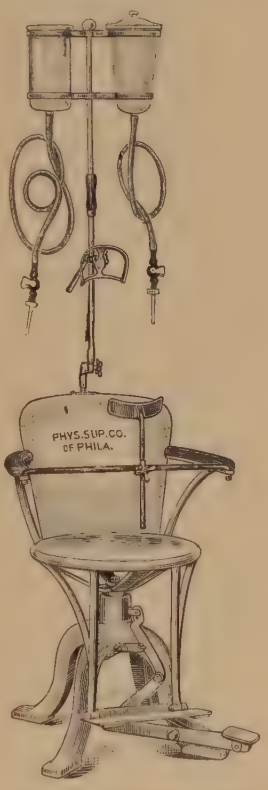


FIG. 129.—Rotating chair complete with douching attachment.

The fistula test presupposes the existence of a fistulous opening between the cavity of the tympanum and the labyrinth and also a perforation of the drumhead. Inflation of the tympanum is produced by a pneumatic bulb, such as a small Politzer bag, whose nozzle is introduced into the meatus and surrounded with cotton or other packing which prevents the external escape of the air. Compression of the bulb causes condensation in the tympanum and produces, through the fistula, pressure upon the contents of the horizontal semicircular canal. The result of this manœuver is nystagmus to the same side—the side with the fistula.

The knowledge that the three tests described are normally

[1] The mnemonic syllable, *cows*, beginning with the same letter as caloric (C), may aid in remembering the result of the caloric test. Express that result in the sentence "cool water turns to opposite side, warm water turns to same side"; then put together the initial letters of the four adjectives used, *i.e.*, cool, opposite, warm, same; giving the word, *cows*.

followed by the various forms of nystagmus which have been specified, enables us to employ this ocular phenomenon in diagnosis. It aids us in correctly interpreting the significance of vertigo, nausea and unstable equilibrium and absence of nystagmus after application of the tests, indicates a nearly complete loss of function in the static labyrinth. From a clinical standpoint, the help nystagmus gives in diagnosis is its chief, almost its sole, value and, since this value is in no way dependent upon the hypotheses concerning it, but simply upon the well-proven facts, an exhaustive theoretical discussion is not necessary in a treatise like this whose paramount purpose is to assist the clinician. Readers who desire to pursue a detailed study of the subject can find lengthy and elaborate dissertations in the works of the European otologists, especially those of Vienna. They will also find many pages devoted to its consideration in American books whose authors have closely copied the Austrian writers. For our present purpose it will be sufficient to give an outline of the hypothesis that is generally accepted as explanatory of nystagmic phenomena, and to illustrate this by a single example which, for the sake of simplicity, is the horizontal nystagmus induced by the rotation test.

It is held that the rolling of the eyeball is due to neural impulses, the first of which starts in the motion of cilia upon the inner surface of the semicircular canals. These cilia are bent to and fro by currents which agitate the endolymph, hence the usual statement of the phenomenon is that movement of the endolymph originates the primary neural impulse affecting the eye. Moreover, the lymph-started impulse acts only in the same spatial plane in which it originated, *e.g.*, an endolymph current in the horizontal canal gives rise to an impulse which causes the eye to turn in a horizontal plane and in that plane only. This turning of the eye starts a neural stimulus which, traversing a pathway leading to the cortex of the cerebrum, excites an oculomotor center there located and this center sends forth a second impulse antagonistic to the first and of greater power. This second neurokyme is termed the cortical impulse.

Let us now apply these principles to the phenomenon following rotation of the body which, as already stated, is a nystagmus to the side opposite the direction of the turning. The patient with head erect is seated in a pivot chair which allows free circular movement in the horizontal plane. His body is turned around ten times toward the right, the direction in which the hands of a watch move, when the dial is uppermost (dextrad rotation). The endolymph in the two horizontal canals participates in this motion. That contained in the other canals is not affected. When the body's rotation stops, the endolymph continues to move by virtue of its physical property called "the inertia of motion," until it gradually comes to a state of rest. Thus there is produced a lymph current which in the right-hand canal flows from the ampullar end toward the small end and, by so doing, starts a vestibular impulse causing a slow horizontal rotation of the eye toward the same side, a dextrad turning. This turning of the eye excites in the brain a cortical impulse, which antagonizes the vestibular impulse and, being stronger, reverses the former's effect, hence the slow rotation of the eye above mentioned is promptly followed by a quick rotation in the opposite direction, sinistrad turning, and this quick motion is designated as the nystagmus produced by the turning test. At the same time, a lymph current in the left-hand canal is flowing from the small end toward the ampullar end and, by so doing, starts a vestibular impulse causing a slow rotation of the eye toward the opposite, right side. The cortical impulse excited by the stimulus originating in the eye motion reverses this effect and causes a stronger, faster rotation in the contrary direction; that is, a sinistrad turning, a quick motion designated the nystagmus. From the foregoing statements it follows that, when the endolymph is put in motion by the rotation of the whole body to the right in the horizontal plane, the actions taking place in both of the horizontal semicircular canals coöperate in exciting neural impulses which bring about a sinistrad, horizontal nystagmus, which affects both eyes and is clear and distinct, since in the final phenomenon all the forces act together

without counteracting factors. Similar theoretical explanations have been worked out for the other nystagmic manifestations and they are very ingenious but they do not add anything to the empirically acquired information already possessed, the facts which are an aid in diagnosis, nor can they give us any help in therapeutics.

When we are dealing with an inflammation of the inner ear, affecting the auditory labyrinth, or both it and the static mechanism, we confront morbid conditions of the most serious kind, and the region affected is so difficult of access that our ability to modify and improve these conditions is very limited. If the labyrinthitis is of the circumscribed type it may spontaneously disappear by a process of gradual devitalization leaving permanent impairment of the hearing to a greater or less degree. This, though not recovery, is the most favorable termination we can anticipate and there are no therapeutic measures by which its occurrence can be promoted, except possibly antifebrile constitutional treatment, whose value is doubtful. When the disease is of the suppurative type, or reaches the purulent stage, the delicate mechanism of the cochlea is hopelessly disorganized and destruction of the hearing becomes inevitable. The prognostic problem ceases to be one of preserving an invaluable special sense and becomes one of preventing the patient's death. To ward off intracranial complications is the urgent demand of the situation and the best hope of doing this appears to consist in making a free vent for the purulent fluid on the exterior side of the labyrinth, opening all receptacles which might retain it and rendering the emptied cavities as aseptic as possible, at the same time saving, to the best of our ability, interior walls which may still serve for the protection of the meninges.

It was to accomplish these results that the Hinsberg operation was devised. It is performed under general anæsthesia and is divisible into five stages. The first is identical with the radical mastoid (Stacke-Schwartze) operation and takes away everything which must be be removed as far as the tympano-labyrin-

thine septum. The second penetrates this partition, gaining access to the internal ear. The ledge of bone overhanging the anterior margin of the facial ridge is clipped off with cutting forceps, the stapes is extracted by a movement combining slight traction with oscillation and the round and oval windows are turned into one by breaking up the intervening bone; epinephrin chloride, in a solution of one in two thousand, is then applied to the labyrinthine surfaces with a small swab of cotton introduced through the opening thus enlarged, so as to secure ischæmia during the subsequent procedures. In the third stage, the vestibule is opened up in a way to provide for its thorough drainage. The upper part of the prominence of the horizontal semicircular canal is uncovered by removing the spongy superimposed bone in thin shavings with a small, sharp gouge. When the ampulla is exposed, it is opened from above, a free vent being made by cutting away nearly half of the bulbous tube but leaving the lower part of the sheath intact. Through the opening into the vestibule its interior should be explored, visually and with a probe, and any necrotic bone or other morbid product removed. In the fourth stage the auditory labyrinth is subjected to dissection similar to that just performed in the static portion, the object in both cases being removal of diseased tissue and subsequent drainage. The promontorium, which is formed by the lowest part of the cochlea, must be removed and to reach it some further shaving of contiguous bone may be necessary, but normal osseous tissue is spared as far as possible. When made accessible, the promontorium is ablated with the gouge, laying bare the larger end of the cochlea. The first whorl of this structure is now cut away, the integrity of the remainder being preserved. With this procedure upon the cochlea, the Hinsberg operation is virtually complete, the fifth stage having reference entirely to repair of the lacerated tissues. Sterile gauze packing is employed to fill the cavities left in the internal ear and this packing connects with that in the tympanic and antral spaces whose postoperative treatment in connection with the Stacke-Schwartze method is

set forth in Chapter XXXIII, where description is given of the plastic technique and of other steps which are equally applicable after the Hinsberg procedure.

Regarding end results, it may be said that the consequences of operation upon the labyrinth are very similar to those observed in the spontaneous subsidence of a circumscribed labyrinthitis accompanied by abolition of auditory function, except that there is some disfigurement due to the surgical measures employed. Aside from this we have in both cases total deafness on the affected side, but little impairment of static control which tends to regain nearly normal conditions in course of time, and usually but little tinnitus and no impairment of constitutional vitality. The operation is credited with saving life in many cases of severe purulent labyrinthitis.

Brief reference should be made to some occupational affections of the internal ear. "Boilermakers' deafness" is due to the continuous succession of strong vibrations caused by driving and clinching rivets in boilers and in the steel beams and girders used in erecting high buildings. It produces some hyperplasia of the drum-head, but does most harm to the cochlea. Its progress may be retarded by wearing an auricular hood filled with cotton or inserting in the meatus a tiny rubber bag containing alcohol, but the only sure prophylaxis is change of occupation.

The caisson disease is caused by working in compressed air, used in laying the foundations of bridges and in tubes at the bottom of rivers. It affects the entire body but the damage to the labyrinth is due, not so much to the compressed air itself, as to a sudden change from it to an atmosphere of normal density. Under pressure an unusual proportion of air is absorbed by the plasma of the blood and when the pressure is suddenly removed, this absorbed air separates from the blood in bubbles. Ordinarily the coats of the veins and arteries can bear this centrifugal pressure, but it does irreparable damage to the delicate structure of the cochlea. The danger can be obviated by a gradual decrease in the density of the atmosphere, such as is effected by

interposing two or three reduction chambers between the compressed-air room and the entrance shaft where there is the average outside pressure. The air density is successively diminished in these chambers and passage through them causes the pressure within the body to approach the normal standard, before the outer atmosphere is reached.

The violent vibrations caused by the firing of cannon may rapidly injure and even destroy the hearing, though there is much variation in the resistance offered by different individuals. This danger has been augmented in recent times by the increased size of the guns used in field artillery. Soldiers have devised a method of prophylaxis which seems to have escaped the notice of writers on otology. Veterans advise new recruits to save their hearing by looking directly at the muzzle of cannon being fired. The posture thus given to the head greatly weakens the atmospheric impact upon the drum-head, for the vibratory waves radiate in every direction from the gun's muzzle and those passing by the observer's face impinge against the tragus and slant off past the antitragus and helix, exerting far less force upon the membrana tympani than if they had penetrated the external auditory meatus in a straight line. Yawning at the moment the gun is discharged lessens the liability to injury by equalizing pressure.

In what has been said of the static labyrinth, I have assumed the correctness of the generally accepted theory which assigns to it gubernatorial functions regarding the body's equilibrium and relations to space and motion; an hypothesis, which involves principles of sciences distinct from physiology, especially the laws of physics and mechanics. This theory has been adopted by most otologic authorities and it serves as an explanation of symptoms and other phenomena and hence is an aid in clinical study. Nevertheless the reader should be apprised of the fact that it does not rest upon very solid ground. Prof. Neumann, in his writings and especially in his oral instructions to our class, taught that we might antici-

pate gradual amelioration of vertigo and other symptoms, even when incurable disease of the labyrinth was steadily, though slowly, advancing. He showed that as the internal ear became less and less responsive to stimuli, the symptoms tended to subside, and he reasoned that when the disease had finished its injurious work and the labyrinth had become an inert mass, this subsidence would be complete. His statements were doubtless entirely correct; but neither he nor others appear to have pursued this line of reasoning to its logical conclusion, nor shown its ultimate effect upon the doctrine of the physiology of the static labyrinth. If the internal ear upon one side is functionally dead, whence comes the regulation of equilibrium? It will be answered that the normal organ on the other side does double work, just as after a nephrectomy the remaining kidney takes up the task of the one removed. But even when both labyrinths have become functionless, precluding such compensation, the subsidence of symptoms still takes place. Moreover, necropsies have shown that in certain deaf mutes there were non-functionating labyrinths from the time of birth or early infancy, and yet many of these mutes had not exhibited any notable abnormality in regard to equilibrium or the spatial relations.

Equilibrium and motion in space depend upon three things: the vestibular apparatus, sight, and the muscular sense which recognizes the direction and force of gravitation. Some aid also is given by the tactile sensations. Under normal conditions the stability of the body is comparable to that of a tripod. Balance can be maintained by voluntary effort when any two of the functions are normally performed, as is the case in the dark or when the eyes are closed, conditions in which no assistance is given by the ocular sense. It is hardly possible for one function alone to maintain equilibrium. Disease of the labyrinth disturbs balance and confuses spatial relations by giving rise to variable and false impressions. When the labyrinthine function has been entirely abolished, this dis-

turbing element is eliminated and equilibrium regains a fair measure of stability through the coöperation of the two remaining functions.

The excitation of the semicircular canals giving rise to vertigo and nystagmus and thereby eliciting certain phenomena, which have diagnostic value, has been considered in a former part of this chapter, where the influence of rotation upon the horizontal canals is explained as an illustration.

Quite recently the utilization of canal-excitation for diagnostic purposes has been greatly extended by the introduction of a procedure termed past-pointing, which is novel both in its action and in the object to be attained. The discovery of this diagnostic sign is credited to Barany, the otologist of Vienna. Some Philadelphia physicians who were sojourning abroad made themselves familiar with the subject and, when they returned home, undertook to impart their information and to repeat and develop the work done in Vienna. Through their influence a department of Neuro-otology was established in the University of Pennsylvania and facilities furnished to thoroughly study past-pointing, nystagmus and cognate subjects. In the group of able men, who have promoted the success of this new departure, Dr. Isaac H. Jones is conspicuous for his earnest and assiduous labors. By giving me information of the highest value he has placed me under an obligation which I most gratefully acknowledge.

In discussing a subject like past-pointing which is not only new but somewhat abstruse and difficult, we should strive to secure absolute clearness and plainness of statement. Ambiguity is often caused by using the same adjective to describe words which embody an idea of change and also words implying stability. To avoid obscurity of this sort, I shall restrict the use of *normal* to such terms as process, reaction, transmission; while employing *healthy* to describe organ, body, patient and similar substantives.

The technique of past-pointing is as follows: The patient sits in the erect posture (occupying the special chair, Fig. 129) with

right arm and forearm extended before him, the hand and index-finger in a horizontal line; the other fingers and thumb being flexed in the palm. The physician sitting directly opposite has his left elbow flexed with forearm, hand and fingers in the posture just described. A space of six inches separates the knees of the two. The patient lays his extended index-finger upon that of the physician producing bidigital contact for two or three inches. The patient now closes his eyes and endeavors to remember as fully as possible the position of his finger: he then lifts the right arm to a vertical position and slowly brings it down to its former level trying in so doing to restore the bidigital contact. This effort is generally successful and if the patient misses the doctor's finger, which has not moved, he comes very close to it. If the experiment be repeated many times, it will be found that in a large majority of the trials the two index-fingers come together. This result is due to the fact that the patient's muscular coördination and static sense are able, in conjunction, to give correct guidance without the aid of sight. In this procedure it is presumed that the musculature of the patient's right arm and shoulder and the controlling nerves are in a fairly healthy state.

The next step is to produce excitation of the semicircular canals either by rotation or by thermic change. While this excitation continues there is a repetition of the movements already detailed from the closure of the patient's eyes till his right index-finger drops into the horizontal plane. What happens at this stage must be clearly understood as it is the essential feature of the past-pointing test. It is found that in many patients the descending index-finger not only fails to touch the stationary finger of the physician, but deviates ten inches to the right or left. This is caused by a neural impulse, starting in the semicircular canals and reaching the forearm which diverges to one side. Those showing this deviation include a group of patients who neither at that time nor any other have presented evidence of brain disease and also a group of persons, not patients at all, but robust individuals submitting them-

selves to experimentation to show what features of these phenomena are physiological and free from any pathological element. In view of these facts the occurrence just described is termed "the normal reaction in past-pointing." It is the usual, proper reaction following the stimulation of the canals in persons with healthy brains. In so far as intracranial lesions are concerned it gives a negative result; that is, it does not indicate either their presence or absence; for a disease might be so located as not to modify the reaction.

We now turn to a group of patients, in whom excitation of the canals does not cause deviation in past-pointing. With closed eyes they are able to restore the bidigital contact, just as though no stimulus had been applied. It is plain that something has suppressed the neural impulse originating in the canals; and it is a clinical fact proved empirically that this group of patients comprises most of those affected with disease of the brain. The nugatory result of excitation of the canals is distinguished from that previously described by calling it "the abnormal reaction in past-pointing."

Before endeavoring to explain the diverse consequences of canal-excitation, attention must be directed to the fact that cases in which the functions of the canals have been destroyed. or very seriously impaired, are wholly excluded from consideration; indeed their exclusion is implied by the very words used in describing the procedure; for there cannot be excitation of a functionless, inert organ.

In the normal past-pointing reaction the deviation was caused by a neural impulse starting in the canals and traveling by a long route to the nerves controlling movements of the patient's right arm. When under identical conditions of canal-excitation this deviation does not occur, the only rational explanation is that the neural impulse has failed to reach its destination because of an impassable barrier somewhere upon its pathway. It is most unlikely that this barrier is in the nerve supply of the upper extremity on the right side, because any obstruction capable of intercepting the impulse would, in this region, man-

ifest its presence by other obvious signs of nervous or muscular abnormality; the right arm would be considered unfit for use in the past-pointing experiment and the left would be substituted in its stead. There is very strong probability that the barrier exists in the centers of the nervous system, in the cerebrum, cerebellum or medulla. There is no doubt that a tumor pressing upon the nerve constituting the passageway of the impulse from the canals could intercept it and likewise its normal transmission could be prevented by other brain lesions. In this fact consists the peculiar diagnostic value of past-pointing. The intercepting of the neural impulse indicates that an abnormal growth or a morbid process exists upon the route of transmission from the static labyrinth to the musculature concerned in the past-pointing movements.

In accordance with the researches of Dr. Jones, it is held that the horizontal and vertical canals, on each side, possess distinct and separate pathways, or arcs, over which their impulses are transmitted. These arcs occupy specific locations in the intracranial region. When excitation of the canals shows that some of them successfully send out impulses, while others do not, the obstruction must be situated upon the arcs of the canals which fail in this act. The positions of such arcs, as far as known, give valuable aid in localizing intracranial lesions.

Past-pointing promises to be very useful when conjoined with other well-tested procedures in solving diagnostic difficulties concerning disease of the cerebrum, cerebellum and medulla. Already the neuro-otologists of the University of Pennsylvania have collected a store of valuable information. They have collated the histories of 125 carefully watched cases, nineteen of which came to operation: in these instances the deductions made from the reactions were to a great degree confirmed by what was discovered during operation; likewise, in four fatal cases, the post mortem findings proved corroborative of the diagnosis made during life.

The following condensed narratives describe methods frequently employed, reactions elicited and arcs of transmission

traversed by the neural impulse between the semicircular canals and the boundaries of the intracranial region. The route taken outside of the skull is of minor importance for the purpose we have in view.

No. 1. When the patient's head has been thrown backward (90°) cool water (68° F.) is injected against the right drum-head. The normal past-pointing reaction takes place; the descending index-finger fails to restore the bidigital contact and deviates ten inches to the right. At the same time there is horizontal nystagmus to the left, both manifestations being caused by excitation of the right, horizontal canal now in a vertical position. The arc of neural transmission extends from the canal by way of the auditory (VIII) nerve to the triangular nucleus, the nucleus of Deiters and the posterior, longitudinal bundle. A lesion in this locality would intercept the neural impulse and change the normal reaction to the abnormal.

No. 2. Warm water (112° F.) is injected against the right drum-head. There ensues the normal past-pointing reaction with deviation of ten inches to the left and nystagmus toward the right. The neural arc is the same as in No. 1.

No. 3. Rotation to the right with head erect ten turns in ten seconds. This elicits the normal past-pointing reaction and the finger deviates toward the right a foot and a half. This is due to the simultaneous excitation of both horizontal canals and is accompanied by nystagmus to the left. The neural arc is the same as in Nos. 1 and 2, for the right side, and it passes through the corresponding nerves and nuclei upon the left side.

No. 4. Rotation to the right, ten times in ten seconds, with head bent backward at an angle of 90° from the vertical. This produces excitation of the vertical semicircular canals on both sides. The finger deviates far to the left and in both eyes there is nystagmus toward the right. The neural arc in this case differs from those formerly described. It traverses the auditory (VIII) nerve and directly enters the posterior longitudinal bundle whence it passes through the middle peduncle to the cerebellar nuclei.

To the diagnostic indications given by nystagmus and past-pointing must be added those furnished by the presence or absence of vertigo.

In persons whose condition is normal vertigo ensues upon excitation of the semicircular canals, especially the stimulation produced by the caloric test. This vertigo may be marked by obvious signs, or it may be very slight causing no objective phenomena and manifesting its presence only in the subjective experience of the patient who says, "I am dizzy: I feel confused." Vertigo is always elicited by excitation of the canals, when the intracranial conditions are altogether normal; therefore the entire absence of vertigo, after vestibular stimulation, indicates that there is a lesion affecting the arcs or pathways conveying neural impulses from the labyrinth to the centers in the cerebral cortex.

Our conclusions concerning brain lesions should be based upon repeated tests and a very careful collation of the results pertaining to each of the three diagnostic factors; nystagmus, past-pointing and vertigo.

It is not possible in the present state of our knowledge to map out accurately all the neural arcs nor can full details of each method of causing excitation of the six canals be given within the limits of this discussion. The four cases specified indicate methods to be pursued in a more comprehensive study of the subject. Doubtless in the near future our knowledge will be broadened and rendered more accurate.

CHAPTER XXXVI

INTRACRANIAL COMPLICATIONS OF EAR DISEASE

In preceding chapters there have been frequent allusions to the danger that diseases affecting the ear may extend from it into the cranial cavity, such extension constituting the gravest consequence or complication of aural maladies. The auricle and cartilaginous portion of the meatus are the only parts of the ear outside of the skull, all the rest being situated in cavities contained in the temporal bone and inclosed either wholly or partially by osseous walls belonging to its structure; yet so long as morbid processes are limited by the boundaries of this bone they seldom imperil life, though some of them greatly endanger the auditory and static functions. As soon, however, as the disease passes the boundaries of the temporal bone and enters the cranium, the prognosis becomes much worse; the centers of vitality are subject to direct attack, and there is scarcely any time for the action of remedies or for mustering the resistant forces of the body itself. The probabilities are against the patient, but even under these adverse conditions recoveries take place, and the very difficulties of his task are a challenge to the skilful and courageous physician to use every power of his mind and every resource of his art in a supreme effort to win a victory against multiplied odds.

Although all the complications under consideration have their field within the skull, there is a difference in location which greatly influences their prognosis. An extradural abscess occupies a place immediately inside the bony wall, upon the surface of the dura mater. By its enlargement it makes an indentation in that membrane and also in the arachnoid and

pia mater, pushing them before it and compressing the subjacent parenchyma of the brain, so that the space occupied by the abscess is described on the brain side by an ovoid curve and on the skull side by a nearly flat surface. The purulent content of the abscess thus impinges upon the brain and makes for itself a cup-shaped nidus by displacing the brain substance, but it does not penetrate that substance nor infiltrate it, and this distinction makes such a great difference that the mortality from extradural abscess is less than ten per cent. It seldom endangers life except by acting as a septic focus. The other intracranial complications, meningitis, sinus, thrombosis and abscess, either cerebral or cerebellar, have a very high mortality.

The process by which extradural abscess is produced by chronic purulent otitis media (by far its most common cause) appears to be the following: The prolonged suppuration leads to inflammation and necrosis of the roof of the tympanum, bringing infectious material into contact with the adjacent area of the dura mater. This toxic matter irritates the membrane, but at first its quantity is very small, for when necrosis has penetrated the bone the primary perforation is minute and the morbid action is very slow; hence the resistance incited in the dura mater is quite sufficient to thwart the disease. There is proliferation of plastic material, the membrane is thickened and the septic matter is inclosed by a fibrous wall. If the disease of the middle ear were arrested at this stage, the pathogenic material would remain encysted and perhaps give no trouble; but the enemy is continually reinforced, the necrotic orifices grow larger and the pressure against the retaining wall constantly increases. The wall is stretched, more fibrin is deposited and the barrier assumes a resilient, elastic character. For a while it withstands the encroachments, but the difficulty of making room, by compressing the brain substance, keeps on growing and the pyogenesis continues until at last the balance turns in favor of the disease and nature is defeated. The process detailed seems to be the usual one,

but extradural abscesses may also originate in an infected embolism in one of the meningeal blood vessels, without the agency of osseous necrosis, and the route of infection may be through the labyrinth. The course of such an abscess varies with the character of the bacterial infection upon which it depends, and among the germs commonly responsible for this complication the bacillus of influenza is peculiarly virulent. When it is the etiologic factor, the progress of disease is faster and the prognosis worse than under other conditions.

What has been already said of the gradual process by which an extradural abscess is usually formed makes it plain that an early diagnosis is difficult, unless the condition is discovered during an operation upon the mastoid. In this case there may be exhibited proofs which leave no room for doubt. If the surgeon upon opening the mastoid cells is greeted by a notable flow of pus escaping under pressure and if, when the surplus liquid has been evacuated, the residual mass shows agitation, pulsating in unison with the action of the heart, the cavity holding the fluid must be connected with an intracranial purulent mass, and the rhythmical pulsation may be caused by motion transmitted from the carotid artery not far off, or may be an expression of general brain pulsation. Aside from discovery during operation on the mastoid, the presence of an extradural abscess is a matter of inference which is far from positive, as there are no pathognomonic symptoms. There is usually upon the affected side, dull headache which is nearly continuous, and this is accompanied by slight elevation of temperature. Unless the abscess is very large there are no symptoms of pressure upon trunks of sensory or motor nerves. Occasionally spontaneous recovery takes place by evacuation through the ear, the pus taking a retrogressive route through the necrotic bone which was the pathway for infection, but this favorable termination is not frequent.

The object of treatment is to empty and drain the abscess without damaging the plastic barriers which have protected the brain. This can generally be effected by ablating the

tegmen and, after the escape of the pus, irrigating the cavity with a solution of mercury bichloride, 1 to 5000. The preliminary steps leading up to the removal of the tegmen are those of the radical mastoid operation described in Chapter XXXIII. The abscess is nearly always close to the tegmen and easily reached after that bone has been cut away. If it is not found at that point, a probe should be introduced between the dura mater and the skull and moved about carefully in an effort to disclose the locality of the abscess. When found, it should be emptied directly through the osseous cortex covering it. The removal of sufficient bone at this place is far better than incision of the protecting fibrous wall. Only when no other route is available should the pus be drawn off through this barrier, and then the antiseptic irrigation should be immediately used. Sterile gauze is applied as a postoperative dressing for the abscess cavity and in other respects the same technique is employed as in the mastoid procedure. The size of the cavity soon diminishes on account of the release of the compressed brain substance which, after pressure is removed, resumes its normal place.

In passing from the consideration of extradural abscesses to other intercranial complications we take up a group of diseases whose death-rate is appallingly high and which, not many years ago, were considered necessarily fatal. At the present time prompt operation will save a proportion of patients, but the mortality is such as to lay the very strongest emphasis upon prophylaxis, upon such energetic treatment of the aural diseases as shall prevent their extension to the brain. The lateral sinus, either in its horizontal or sigmoid portion, may be the seat of a thrombus originating as do other thrombi from changes in the structure of the venous walls, but such a thrombus usually begins as a septic clot. It is seldom large enough to block up the sinus, and for a considerable time after its formation it is liable to remain adherent to one side of the sheath, causing hardly any local symptoms. After a while morbid changes in the sinus wall take place, producing disintegration

which spreads to the thrombus and it then rapidly degenerates, setting free in the circulation multitudes of pyogenic bacteria. This occurrence gives rise to marked constitutional symptoms, a sudden and severe chill and a rise of temperature to 104° or 105° F. Then follows a remission, when the temperature becomes nearly normal; but in five or six hours there is another chill and another high marking of the thermometer. These alternations continue, as horde after horde of hostile germs spreads through the body, inducing septicæmia and exhausting the vital powers. The earlier an operation is performed the more chance it has of success. Its first step is to ligate the jugular vein in the neck; the second is to open the sinus through the mastoid, removing enough of the exterior wall to gain free access to the thrombus which must be thoroughly scraped away with a dull curette. All diseased tissue and all morbid products must be removed, so as to effect complete evacuation and extirpation of the jugular cavity. A thrombus is sometimes formed in the cavernous sinus and in this situation is very likely to prove fatal; but there are recorded cases where this sinus, so difficult of access, has been emptied of its contents and cleansed by the Hartley-Krause operation performed in much the same way as for Gasserian extirpation.

Cerebral abscess is, in a great majority of cases, the result of chronic disease of the middle ear. Statistical information collected by many observers shows that eighty-five per cent. of the cases are due to this cause. The first stage is often one of partial latency and may point to a general toxæmia rather than to a local lesion. Gradually symptoms of intercranial pressure appear. There is severe headache, pyrexia of intermittent type and vomiting which, unlike that caused by gastric diseases, has no relation to the taking of food and frequently is without nausea. As the abscess grows, psychic symptoms—aphasia, stupor, delirium and others—supervene.

Cerebral abscesses occur most frequently in the sphenotemporal lobe, and it is a matter of importance to determine an area upon the outside of the skull which corresponds with the

region where the lesion is likely to be found. This area is mapped out by Kronlein's landmarks, whose demarcations produce several geometrical figures, the one designed for our present purpose being a square whose side measures from an inch and a quarter to an inch and a half, in proportion to various sizes of skulls (Fig. 130). The lower side of this square is a segment of a horizontal line, termed "Read's base line," extending from the lower margin of the orbit to the occipital protuberance. The upper side of the square is a segment of a line parallel with "Read's base line," beginning at the supra-orbital margin and produced backward. The anterior vertical side of the square is made by a perpendicular line produced upward from the condyle of the lower jaw, and the posterior vertical side is made by a perpendicular, tangent to the posterior margin of the mastoid. This square, called "Von Bergmann's area," covers the region where suppuration usually occurs and here the bone should be perforated. Access is gained by prolonging the incision through the soft parts made in the Stacke-Schwartze operation (see Fig. 131), and turning back the flaps. A trephine is then employed to remove a circular piece of the squamous portion of the temporal bone, in the upper part of the square just described.

While the collated experience of many surgeons proves that the abscess can usually be reached by a perforation within Von Bergmann's area, this is not always the case and it is so important to discover the best route of access that before operating I adopt, whenever possible, a preliminary precaution. This is to hold consultations with an ophthalmologist and a neurologist to ascertain whether either the appearance of the eye-ground, or the neural symptoms and reactions, give any help in localizing the accumulation of pus. Such consultations are not always practicable. The urgency of the situation may not allow sufficient time to secure the services of the specialists required and there may be other obstacles, which one cannot surmount; furthermore, in many instances the ocular and neurologic findings add nothing of real value to

the indications already known; nevertheless, it is judicious for the otologist to seek such coöperation whenever available, and to give due weight to any new information it may elicit.

When the osseous cover of an abscess has been removed by trephining, the dura thus exposed is carefully inspected and if the membranes are found to be œdematous, congested or adherent, we conclude that the diseased area is very near. If the dura is lightly touched with the finger and pulsation is absent or very feeble, this interruption indicates the close proximity of the abscess. Sometimes the patient is in such imminent danger, that we are forced to evacuate the pus at once, despite the risk of spreading septic inflammation; but if the conditions justify a brief delay, the surface of the arachnoid is touched with pure, liquid phenol, an occlusive dressing of sterile gauze is applied and the head encircled by a retaining bandage. Eight hours are allowed for the phenol to produce its effects. If this application has the result desired, we will find at the expiration of the period of delay that the phenol has incited a plastic inflammation with exudation of lymph, which seals up the sub-arachnoid space and all the interstices beneath the dura, thus surrounding the purulent mass with a wall which prevents further invasion of the meninges and gives the opportunity to remove by evacuation and subsequent irrigation the purulent fluid, not only partially, but altogether.

Whether we have secured this favorable condition, or are compelled to open an abscess without inclosing walls of lymph, the incision to be made is designed to give the best possible outlet to the suppurating mass. We make an adequate opening through the dura by lifting it with a small tenaculum and then with a pair of small scissors make a dural flap large enough to permit the thorough inspection of the brain substance lying underneath. This flap is turned to one side and then an incision into the brain made with a sharp, slender scalpel. This instrument is preferable to a trocar and canula because its keen edge causes less laceration than a duller implement and because a canula, through which pus is flowing

is liable to be clogged by some particle of solid matter. If the knife does not upon its first thrust release the contents of the abscess, the blade must be inserted in different directions until the outflow of pus shows that the mass has been punctured. After withdrawing the liquid immediately accessible, drainage should be maintained by a double rubber drainage tube, secured with a safety-pin outside of the external wound to prevent its slipping inward. This tube is also used for irrigation with normal salt solution which should be practiced each day.

A light protective dressing is used over the wound during the process of repair by granulation. In every procedure connected with brain abscess—preparation, operation and post-operative treatment—the strictest asepsis is indispensable. Convalescence is slow and supporting constitutional treatment may be required throughout its course.

Cerebellar abscesses, which are about half as numerous as those of the cerebrum, are treated in a similar way. The area best adapted for perforation with the trephine, to reach the usual locality of the lesion, is a circle half an inch in diameter, inscribed three-eighths of an inch below and behind the inferior, posterior corner of Von Bergmann's area (Fig. 130I), and the dermal incision and osseous perforation are similar to those illustrated in Figs. 130 and 131.

Meningitis due to aural disease exhibits at the onset the same symptoms as when it has a different origin. There is the initiatory chill, the high temperature, rapid pulse and excruciating pain in the head and neck. When the spinal cord is involved there is also the pathognomonic sign of opisthotonos, the bending of the trunk like a bow, while the head is strongly retracted. The disease appears in two forms, the serous in which the prognosis is rather hopeful, and the purulent which is almost uniformly fatal. A differential diagnosis is often aided by the lumbar puncture, now widely employed for this purpose and also as a therapeutic measure. If the trunk be encircled by a line touching the crest of the ilium on

both sides, this line will pass over the spine of the fourth lumbar vertebra just below the third lumbar intervertebral space, chosen by general consent as the point for puncturing the spinal canal. A strong, hollow needle, two inches in length and carefully sterilized, is suitable for making the perforation. In health the cerebro-spinal fluid escapes through the needle when

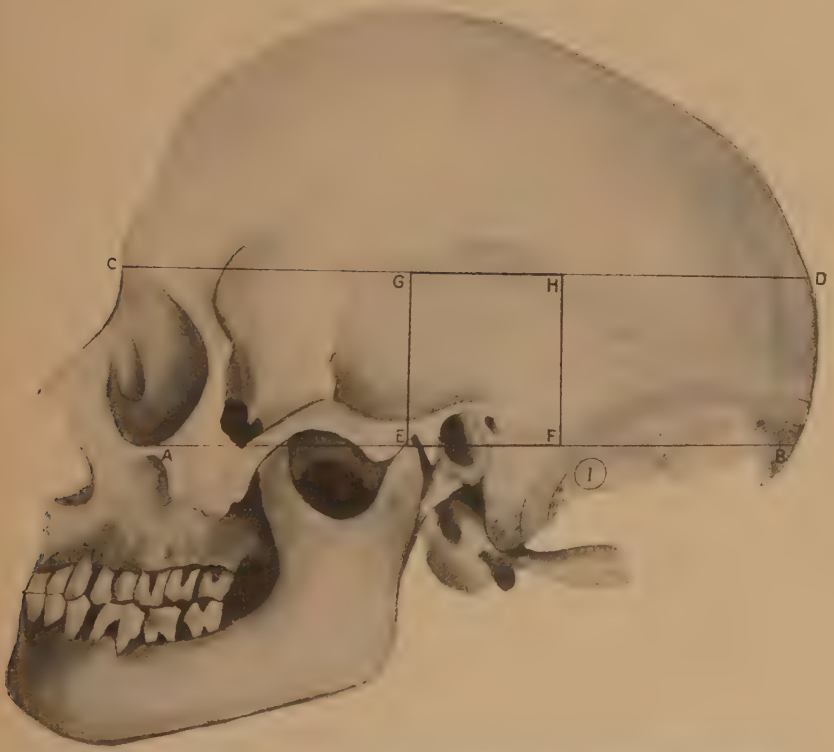


FIG. 130.—Guiding landmarks used in locating brain abscess. Read's base line is indicated by the letters *AEFB*. The square *EFIIG* is Von Bergman's area. *I* indicates locality of cerebellar operation.

its point has entered the canal, drop by drop, but in meningitis the intraspinal pressure is so much increased that for some seconds there may be a steady stream of the liquid. In purulent meningitis pus is always present in the cerebro-spinal fluid. If it is very abundant, it may give rise to a cloudy

opacity easily recognized; when the quantity is small, the microscope will detect pus cells and their presence may also be determined by the aid of chemistry. The normal fluid has an alkaline reaction, but pus renders it acid; so, too, dextrose which is a constituent of the fluid in health is destroyed by the suppurative process and its absence can easily be shown by

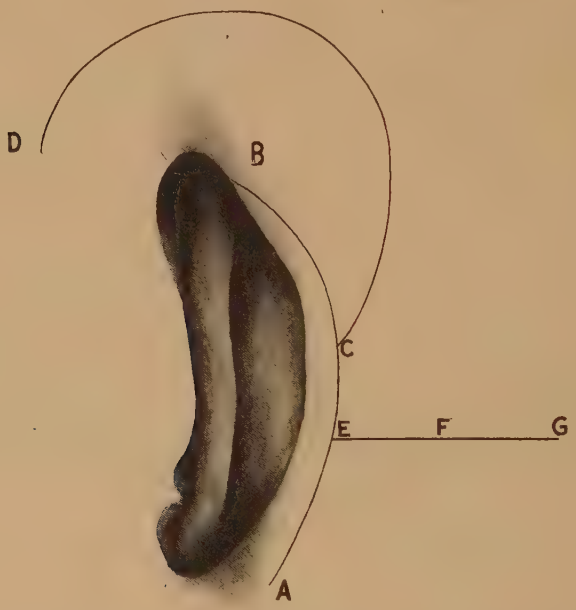


FIG. 131.—For a cerebral operation the area of the cortex exposed by the Stacke-Schwartze incision, *AB*, is enlarged by the curved section *CD*. In case of operation upon the cerebellum, the Stacke-Schwartze line *EF* is prolonged to *G*.

the addition of a few drops of Fehling's solution, the well-known test for sugar in the urine. If the copper salt in the reagent is not reduced by admixture with the fluid under examination, pus is present and there is meningeal suppuration. The therapeutic value of the lumbar puncture arises from reduction of the excessive intracranial pressure by lessening the quantity of the cerebro-spinal fluid. The withdrawal of several drams often greatly ameliorates the pain, muscular

rigidity or clonic spasms. The effect of the measure upon these symptoms is the gauge for its employment. Aside from this expedient, the treatment is expectant and aims to relieve the patient's suffering and to sustain his vitality, until the natural power of resistance may overcome the disease.

CHAPTER XXXVII

DEAFNESS AND MUTENESS

In the sociologic classification adopted by the National Conference of Charities and Correction, the Deaf-mutes constitute Class 2 of Group C., the Defectives.[1] In countries of which we have statistics their number varies from 1 in 3000 to 1 in 500 of the whole population. Their education during school years and their subsequent occupational status are important factors in the complex social problem which confronts civilized society.

The majority of mutes are found among those who are congenitally deaf or have become deaf in early infancy. When at a later period disease or traumatism causes aphonia or aphasia, these defects are rarely accompanied by deafness and, when it is present, its relation to them is not causal. It must be remembered that, as used in this connection, the word "mute" refers not to absence of voice but to want of articulate speech whose physiology is quite different from that of phonation, as was pointed out in Chapter XXI. The normal child emerges from infancy (in + fans = not + speaking) and learns to talk by imitating the utterances of other persons, especially other children. Hearing a word, he tries to repeat it and, after many trials and failures, learns the movements of the articulating organs, which will produce that word, the process being entirely one of imitation and experiment. The child, born deaf or becoming so soon after birth, has nothing to imitate and is wholly excluded from instruction by this method. To express

[1] The other classes of Defectives are: 1. the Blind; 3. Insane; 4. Idiots (feeble-minded); 5. Epileptics and 6. Inebriates. The last two classes comprise only advanced cases, in which epilepsy and inebriety have gone far enough to destroy efficiency.

his desires and give vent to his emotions he must have recourse to pantomine (the primal sign-language) and to nearly instinctive, animal noises, such as cries, screams, howls and moans, sounds whose signification is readily interpreted but have a very narrow range of meaning. Unless the child receives special instruction, he does not go much beyond this and in adult life remains a mute, not because his organs of voice and speech have any anatomical abnormality, but simply because he has never learned to use them for the utterance of words. Children who have acquired speech and subsequently lost their hearing, do not lapse into mutism. They continue to speak in a comprehensible way, but the finer modulations of tone and articulation may be lost because they no longer possess a standard with which to compare their utterances. These facts regarding speech and the lack of it appear commonplace, but they are exceedingly important and it was the neglect to properly comprehend and apply them that for generations prevented progress in methods to instruct deaf-mutes in a way which would rehabilitate them and take them out of the category of "incapacitated defectives."

The first long step taken in the education of mutes was the invention of the manual alphabets, single and double handed, by which words are spelled in a visible way. This device is a specialization of the primitive sign language, but by utilizing the idea of the written alphabet, it so broadens the scope as to include all words in languages having quasi phonetic letters. It cannot be used with an ideographic language like the Chinese. In the two-hand alphabet the signs bear a resemblance to the shape of our printed (Latin) characters, hence they are very easily remembered and were learned by many normal children, who were thus able to communicate with mutes and also employed the signs for silent conversations with each other, actuated by that love for secrecy and mystery, which is such a strong motive in adolescence. The bimanual alphabet was, however, a slow and cumbersome instrument of communication and was before long superseded by the one-

hand alphabet, which greatly increased the speed possible of attainment. By using abbreviations and conventional forms of motion, the rate at which thought may be accurately communicated by expert users of the single-handed alphabet has been developed to an astonishing rapidity. The development of this speed has conferred upon well-trained mutes the capacity for dialogue and also for lecturing before a class or other small audience, in a way that is quite free from the former discouraging tediousness.

This great advantage has been gained at a heavy cost in another direction. Not many persons, except mutes themselves, understand the one-hand alphabet, which is far harder to learn than the bimanual one, with its imitative features. Very few indeed ever devote the time and effort to become expert in its use, hence the rapid hand movements of mutes conversing with each other are wholly incomprehensible to nearly all speaking people and the barrier between them is more impassible than if the mutes had never been educated and were forced to depend upon the primitive sign language and the animal noises which, however narrow their range, were quite well understood by everybody within those limits. It thus came to pass that the work of the great institutional schools for the deaf and dumb, upon which millions of dollars had been expended, had a tendency to segregate their pupils from the rest of the community and to render communication between them and speaking people difficult and hence infrequent. The philanthropic men, who had devoted themselves to the good of this class of defectives, were confronted by a serious economic question: how can the mutes trained in the sign-language schools find remunerative employment? Much the larger part of the rising generation in every land must secure a livelihood by earning it and among mutes the proportion subject to this necessity is even greater than the ratio for the community at large. How shall these young people, handicapped by lack of speech, find work amid the competitive conditions everywhere prevalent? One answer to this question

was that the State should transfer the mutes, upon the completion of their school course, to industrial colonies where they should engage in agriculture and manufacturing of various sorts, creating self-supporting communities, where the sign-language would be the *lingua franca* and where the citizens would be free from the unfair competition of people possessing all the special senses. If this plan had been adopted it might have led to the production of a wholly deaf variety of the human species, for by the intermarriage of the colonists the defect would have been transmitted to the next generation and continued in-breeding would have tended to make it permanent and universal. In addition to inflicting this disability upon posterity the colonial scheme would have worked great injury to the present generation. Such segregation of mutes would have been contrary to the well-recognized sociologic law that "Association based upon a defect is injurious." This is true even if the defect is merely somatic and has apparently no psychic influence. If a community was founded by persons who had each suffered the amputation of an arm, it might at first show certain advantageous results due to the invention of industrial methods which could be pursued by one-armed men, but ultimately there would be mental and social deterioration whose only cure would consist in changing the character of the community by an influx of people who had suffered no mutilation. The project of colonizing the mutes was abandoned in favor of a more rational scheme which constituted the second great advance in dealing with the subject.

This scheme was the introduction of oral teaching, either side by side with the manual sign language, or as a substitute for it. Instruction by this method enables the mute child to acquire speech by watching the movements of the lips and the facial muscles of the teacher who of course makes the motions in a peculiarly deliberate and uniform way. The speech which the pupil acquires is of a poor kind, harsh, inaccurate and often of disagreeable intonation, but it is real speech, expressive of ideas and comprehensible to persons with normal

hearing. In these respects it has immense superiority over the other methods of communication, for it abolishes the segregation of the deaf-mutes and restores them to a place in the general community. It is far better for them and for their progeny that they should take part in the general communal life than seek temporary advantage in segregation, at the cost of deterioration for themselves and their posterity. Competition with normal workers remains a hindrance, but its effect is greatly diminished by oral training, for the comparatively small vocabulary used in any industry is soon acquired by the deaf worker and his practice before long enables him to speak this list of words quite well, so that during working hours his defect is almost in abeyance and his chances of success are fairly good. This is proved by the fact that very few of the lip-reading deaf are found among the destitute classes.

Recently a third advance has been made and one which has peculiar interest for members of the medical profession, for its success and the realization of the hopes of its promoters, depend very largely upon coöperation among those most closely connected with the rehabilitation of deaf-mutes and their restoration to social responsibilities, labors and enjoyments. These are the instructor whose viewpoint is pedagogical, the physician who approaches the subject from the side of aural therapeutics, and the publicist who considers its bearings upon public expenditure, industrial productiveness and the other interests of the Commonwealth. The present trend of thought results partly from the agitation in favor of the oral plan of teaching. It was advocated as a means of imparting the use of spoken words by watching the action of the labial and other muscles, when surdity has made the natural method of acquiring the words impossible and, although the imitation of normal speech which it gave was very imperfect, yet for some purposes it was better than the manual substitute. The current movement aims to come still closer to the natural function by conserving and utilizing whatever fractions of

auditory power may exist, due either to the presence of a small part of the auditory mechanism, produced in fœtal life, before the arrest of development, or to remnants of this mechanism which escaped the ravages of disease that destroyed all the rest. In many so-called "deaf-mutes," domiciled in the institutional schools, the existence of such auditory fractions was for a long time almost wholly ignored.[1] We now know that,

[1] The unfortunate condition formerly prevailing in some schools for mutes, by which the pupils derived no benefit from the progress of otologic medicine and surgery, is shown by the following case, occurring nearly twenty years ago. A lad of eight was admitted to a State school for mutes, was given a uniform and a number and put under instruction, but subjected to no aural examination. Some months afterward he contracted broncho-pneumonia and, on account of the absence of the school physician, was attended by Dr. B., a practitioner of the neighborhood who was convinced by various incidents that the boy was not entirely deaf. Dr. B. asked permission to take the lad, during convalescence, to an otologist, but was refused by the principal with the curt remark, "If No. 144 were not deaf and dumb, he would not be here." Dr. B. though rebuffed was not discouraged. After recovery the boy was allowed to pay a visit to his parents and they were asked for the permission which had been denied. They were poor people of a neighboring village and could incur no expense, but when Dr. B. promised there would be no charge, they gladly agreed to his proposal. The otologist became much interested and aided in securing the case history, which was substantially, as follows: In early infancy, there was "a running from both ears" which ceased after a time, but left the child deaf. He never learned to speak and when eight years old was pronounced a mute by the village doctor who filled out the application papers for the training school. At no time were the ears treated by a specialist. Examination disclosed no disease of the labyrinth and the mastoid seemed to be normal, but the right tympanum was closely packed with a partly organized mass, somewhat resembling a cholesteatoma, though with many differences. The left tympanum was in a similar condition, except that here the mass appeared to be dessicated and had shrunken on the anterior side, leaving a narrow passageway through which some atmospheric vibrations were transmitted to the tympano-labyrinthine partition. In this ear there was some audition; Dr. B. had not erred in his opinion. The mass in the right ear cut off all conduction, but when both tympani had been thoroughly cleansed, this was found to be the better ear, for its ossicles were but slightly damaged, while on the other side they were carious and the hearing in the left ear was only a little improved by removal of the obstructing mass. Considerable auditory power was recovered upon the right side and the boy signified its presence and his consequent delight by signs, for of course he was still mute. His parents wished him to remain at the school, where he was supported free of cost to them, and in spite of his recovered hearing he was trained just as the other pupils, the principal making it plain that he was ill pleased by the otologists'

even when a part of the labyrinth is congenitally lacking, there may be "islands of hearing" which can perform service under proper management and if the defect is in the middle ear, rather than the internal, there is a still better chance of securing some functional action. This modicum of real hearing has a twofold value: it has worth as a means of communicating ideas, a value which can be measured by an equal power possessed by a substitute, such as lip reading, or the manual alphabet, and in this respect its utility can be accurately determined, as neither greater nor less than that of the other medium of transmission. Beside and beyond this value there is another which is strictly *sui generis* and outside the range of any substitute. This is the psychic influence of audition exerted upon the imagination and the emotions. The subject has as yet received little study, but enough to make it sure that the loss of this influence which can proceed from nothing but audition has a permanent and injurious psychologic effect. There is today general agreement that whatever hearing remains in one nearly deaf should be carefully conserved and fostered.

As yet, practical measures are not abreast of theoretical opinion. The specialist on ear diseases, whose name appears in the annual report of a deaf-mute school, is still in many instances an occasional visitor who receives no salary and gives to the institution just what time he can spare, actuated by his interest in otology and his sympathy for the children. The pupils should be under constant medical supervision and, to secure this, the name of the otologist must be on the permanent pay-roll and his services placed upon a business basis. The expense incident to such medical supervision will generally fall upon the public treasury and this implies awakened interest and intelligent coöperation on the part of the fiscal officers of

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interference, but the little fellow taught himself to speak and was dubbed by his companions, "the gabble mute." Later he secured employment with a produce dealer and, though hard of hearing, was able to hold his own among normal boys. He now occupies the responsible post of head bookkeeper in a business house.

the State. This is not far off. The publicist of the future (at least in our country) must and will take an interest in the defective classes and do his part to restore to normal conditions of life those who, through no fault of their own, are now segregated in an isolated group and thus deprived of that equality of opportunity which America wishes to secure for every citizen. Only by the intelligent co-working of educator, otologist and publicist, can we hope to attain the ideal status of the class of deaf defectives, when their number will be reduced to a minimum and when the few who remain in the class will hold a useful, independent and honorable place in the community, contributing to its prosperity fully as much as they derive from its resources.

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